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EDITORIAL NOTE.

The object of this Journal is to record the psychological work of a scientific, as distinct from a speculative character, which has been so widely scattered as to be largely inaccessible save to a very few, and often to be overlooked by them. Several departments of science, sometimes so distinct from each other that their contributions are not mutually known, have touched and enriched psychology, bringing to it their best methods and their clearest insights. It is from this circumstance that the vast progress made in this department of late years is so little realized, and the field for such a journal, although new, is already so large.

Among the readers whose studies the editor will bear in mind are these: teachers of psychology in higher institutions of learning; biologists and physiologists; anthropologists who are interested in primitive manifestations of psychological laws; physicians who give special attention to mental and nervous diseases; all others interested in the great progress recently made in so many directions in applying more exact methods to the study of the problems of human feelings, will and thought. The advancement of the science will be constantly kept in view, and the journal will be a record of the progress of investigations.

The journal will consist of three parts.

I. *Original contributions of a scientific character.* These will consist partly of experimental investigations on the functions of

the senses and brain, physiological time, psycho-physic law, images and their association, volition, innervation, etc.; and partly of inductive studies of instinct in animals, pyschogenesis in children, and the large fields of morbid and anthropological psychology, not excluding hypnotism, methods of research which will receive special attention; and lastly, the finer anatomy of the sense-organs and the central nervous system, including the latest technical methods, and embryological, comparative and experimental studies of both neurological structure and function.

II. *Digests and reviews.* An attempt will be made in each number to give a conspectus of the more important current psychological literature, and to review significant books, bad as well as good.

III. *Notes, news, brief mentions*, etc.

While articles of unusual importance in the field of logic, the history of philosophy, practical ethics and education will be welcomed, the main object of the journal will be to record the progress of scientific psychology, for which no organ now exists in English.

Controversy so far as possible will be excluded.

The journal will be published quarterly.

THE VARIATIONS OF THE NORMAL KNEE-JERK, AND THEIR RELATION TO THE ACTIVITY OF THE CENTRAL NERVOUS SYSTEM.

BY WARREN PLYMPTON LOMBARD, M. D.

The research described in this paper was made with the purpose of studying the variations to which the knee-jerk is normally subject. The observations reported are based on experiments which were made with a hammer which struck a blow of known force, and with an apparatus that gave an accurate record of the extent of the resulting knee-jerks. The experiments were all made on the writer, who is a healthy man; they extended over six weeks; they were made at two hundred and thirty-nine different times; and they numbered six thousand, six hundred and thirty-nine. Of these experiments only five thousand, four hundred and seventy-six are reported in the tables accompanying this paper.

These experiments demonstrate not only that the extent of the knee-jerk varies with the force of the blow employed, but that when blows of the same force are used the extent of the knee-jerk varies greatly on different days, at different parts of the same day, and even in experiments which rapidly succeed each other.

The cause for these variations in the extent of the knee-jerk are conditions which affect the vigor of the muscles and nerves involved in the process, and,

to a still greater degree, all influences which vary the activity of the central nervous system as a whole, or of special mechanisms of the spinal cord and brain.

Of the many names which have been given to this phenomenon, viz.: "knee phenomenon," "patellar tendon reflex," "myotatic contraction," "knee-kick," "knee-jerk," the last has commended itself to the writer, because it calls attention to the peculiar suddenness of the movement, and does not imply anything with regard to the nature of the process.

The author takes this opportunity to express his thanks to Prof. H. Newell Martin and Professor G. Stanley Hall, for their valuable advice and their great courtesy. He takes pleasure, also, in acknowledging his indebtedness to his co-worker in this research. All the experiments were made upon the writer by his wife, and their value is greatly enhanced by the accuracy and care with which her work was done.

METHOD OF PRODUCING THE KNEE-JERK, AND THE NATURE OF THE PROCESS.—Place the subject in an easy position, with his knee partly flexed, and his leg freely movable; then strike the middle of the ligament, just below the knee pan, a sudden blow. The kick which results has a jerky character, which is quite peculiar.

If a man sits with one leg crossed over the other, the quadriceps muscle of the leg that is uppermost is slightly stretched by the weight of the suspended leg and foot, and the chain composed of the quadriceps tendon, the patella and the patellar ligament, which connects the quadriceps

muscle with the head of the tibia, is subjected to considerable tension. If, now, the ligamentum patellæ be struck, it will be suddenly depressed into the cavity of the joint beneath it, and a jerk will be transmitted by means of the patella and the quadriceps tendon to the quadriceps muscle. Whether the muscle fibres and the motor nerve fibres lying in the muscle are directly stimulated by the mechanical irritation thus brought to them, whether the end organs of the sensory nerves in the end of the tendon near the muscle, and in the muscle itself, are excited by the effect of the blow, and transmit stimuli to the muscle through the afferent spinal nerves, the centers in the spinal cord and the efferent spinal nerves, or whether both of these processes aid to bring about the muscular contraction, is unknown. We only know that the result of the blow is to cause a sudden contraction of the quadriceps, which jerks the foot forward in the characteristic manner.

All the methods by which the knee-jerk may be obtained, are merely different ways of giving the quadriceps muscle a twitch by bringing a sudden strain upon its tendon.

Nature of the Process.—Whatever view is held with regard to the nature of the process, all admit that it is very dependent upon the condition of the reflex arc, and that the only matter of doubt is whether the influence exerted by the spinal cord has the form of a reflex action and occurs after the blow has been struck, or whether it is a continuous reflex influence which prepares the muscle by increasing its tone, and thus renders it more susceptible to the irritation resulting from the

blow. The argument that the time is too short for a reflex act is inconclusive on account of our lack of knowledge of reflex times in general, and the attempt to prove the existence or non-existence of muscle tonus has thus far proved futile. The fact remains, however, that the existence of the knee-jerk is dependent on the integrity of the reflex arc, and, moreover, that the extent of the knee-jerk is greatly influenced by the irritability of the spinal cord.

CAUSES FOR VARIATIONS IN THE EXTENT OF THE KNEE-JERK.—It is not the intention of the writer to offer the results recorded in this paper as laws applicable to all men. The influences which determine the extent of the knee-jerk are far too numerous and too subtle to be ascertained by a few thousand experiments on any one man. Although, as has been said, the nature of the knee-jerk is not thoroughly understood, we know it to be an elaborate physiological process, involving the action of many different organs, for both experimentation and clinical experience have disclosed that the normal activity of the quadriceps muscle, of the corresponding afferent and efferent spinal nerves and their roots, and of a certain portion of the cord are necessary to its completeness. Since every condition which influences the action of these different organs must necessarily have its effect upon the extent of the knee-jerk, it is not strange that the phenomenon is subject to many variations. This becomes the more apparent if one considers how many influences are continually modifying the activity of nerve and muscle tissue, and, still more, of the delicate mechanisms of the central nervous

system. Not a few of these changes have their origin in the influence exerted by the different parts of the central nervous system on each other, and there can be but little doubt that the mutual dependence of the cerebro-spinal centers is much greater than has generally been supposed. Indeed, it would almost seem as if the nervous connections were so intimate that a change in the activity of any one of these centers would make itself felt in all the rest, as if, to speak figuratively, there were a balancing of nervous tension throughout the nervous system, so that a change in any one part must be felt in all other parts. Thus, though an increase in pressure, due to a sudden production of nerve force, might, perhaps, encounter less resistance, and so make itself felt chiefly in certain directions, it would produce a slight effect throughout the whole system. The picture represents a condition of things similar to that existing in the circulatory system, where a change of pressure brought about at any part tends to be transmitted to all the rest. Far be it from the writer to offer or support a theory of the action of what we call nerve force. The line of thought has been suggested, however, by the results of his own and similar experiments, which have shown that a strong sensory irritation, a voluntary action, or even an emotion, is sufficient to influence the extent of the knee-jerk. It has long been known that the nervous system binds the many organs of the body into a whole, and that through it the condition of every part is made to have its influence on all the rest, but the closeness of this union has never been illustrated with such startling distinctness as it is in the incessant variations of the knee-jerk.

THE DIAGNOSTIC IMPORTANCE OF THE KNEE-JERK. It is now nine years since Westphal and Erb proclaimed the absence of the knee-jerk in Tabes Dorsalis, and during this time physicians have come to regard the test as a part of the regular routine of physical diagnosis. Nevertheless they have never been quite satisfied with it. In spite of the fact that Berger reported, as a result of the examination of 1409 healthy individuals, that it was absent in only 1.56 per cent., and that Bernhardt stated that he had found it absent in all but two of forty-six cases of Tabes, which he had studied, there have been so many contradictory reports in medical journals, and every practitioner has found so much difficulty in getting satisfactory results in the doubtful cases, that the knee-jerk has been gradually drifting into disfavor. It is probable that a reaction is at hand, for the discoveries of the past four years offer an explanation of many of the apparently inexplicable results, and at the same time greatly extend the usefulness of the symptom.

REËNFORCEMENT OF THE KNEE-JERK.—In 1883 Ernst Jendrassik[1] reported his observation that if the hands were clinched just before the ligamentum patellæ was struck, the resulting knee-jerk was greater than it was when the subject was quiet.

Jendrassik's interesting discovery was made the subject of the most careful study by Dr. S. Weir Mitchell and Dr. Morris J. Lewis,[2] and they were

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[1]Beiträge zur Lehre von den Schnenreflexen.—Deutsches Archiv. f. klin. Med. Bd. 33, s. 177, 1883.

[2]Physiological Studies of the Knee-jerk and of the Reactions of Muscles under Mechanical and other Excitants.—*The Philadelphia Medical News*, Feb. 13 and 20, 1886.

able, not only to corroborate his results, but to show that the knee-jerk was subject to the most extensive variations, even during health, and that these variations probably occurred by means of alterations in the activity of the nerve centres, upon whose integrity the knee-jerk has been found to be dependent. Although the work of these observers is, as far as the writer has been able to test it, correct in every particular, it has been received with a certain amount of scepticism, because their remarkable results are based on observation alone, and not upon any record which can be a proof to others. It is, indeed, wonderful that, trusting as they did to the ability of the hand to deliver a series of blows of constant force, and to the eye to observe slight differences in the extent of the knee-jerk, they should have been able to discover so many facts and to prophesy truly the discovery of so many others. Men who have not their keen power of observation obtain their results with difficulty, and regard them with doubt, and are half inclined to deny all except the results that can be obtained by the coarsest experiments.

THE EXPERIMENTS OF THE AUTHOR.

It seemed to the author that before the knee-jerk could take its proper place as an aid to physical diagnosis, or, still more, as a means of investigating the influences which affect the activity of the central nervous system, there must be devised, first, a method of striking the ligamentum patellæ a blow of known force, and, second, a method of recording the extent of the resulting knee-jerk. If one could be sure of giving the same stimulus throughout a

large series of experiments, and could obtain records of the resulting movements of the leg, one could definitely determine the limits of the normal knee-jerk and the variations which it undergoes under normal conditions. With these thoughts in mind the writer entered upon the research recorded in this paper.

The Apparatus Employed.

1. *A hammer by which it was possible to strike a blow of any desired force.* (See Plate I, Fig. 1.)—Several methods suggested themselves by which one might strike the ligamentum patellæ a blow of any desired force. Of these, the one which upon trial commended itself most highly, was to suspend a hammer by an axis passed through its handle. The hammer could then be made to fall like a pendulum, and would strike a blow, the force of which would depend on the weight of the hammer and on the height from which it fell.

Two instruments of nearly the same construction were employed, the one in the first series of experiments, the other in the second series.[1] The construction of these instruments is shown in Fig. 1, and was in general as follows:

The head of the hammer, *a*, which was made of iron, was 10.5 cm. long, 2.5 cm. wide, and 2.5 cm. thick, and weighed 346.5 gms. It was narrowed at either end to a smooth rounded edge, one of these edges being vertical and the other horizontal.

The handle of the hammer, *b*, a steel rod 22 cm. long and 1 cm. in diameter, weighing 100 gms., passed through a hole which was bored vertically through the middle of the head of the hammer, and protruded a few mm. from the lower side of the head, *c*. The head was fastened to the handle by a screw; and it was so placed that its middle point was just 20 cm. distant from the middle of the axis, which supported the hammer.

The axis, *d*, passed through the handle of the hammer as close as possible to its upper end. It was a steel rod, 5 cm. long and 5 mm. in diameter, and it was pivoted at either end on steel points. The handle was fastened to the axis at about 1 cm. from its inner end.

The screws, *e e*, on which the axis was pivoted, were held by two heavy pieces of brass, *f f*, which extended downward from the horizontal steel rod, *g g*, which supported the whole apparatus, and which was itself clamped at any desired height, on a substantial standard, with a heavy iron base.

A brass plate, *h*, 2.5 mm. thick, was fastened by its upper left hand corner to the supporting rod and to the back of the heavy piece of brass which held the inner pivot, in a plane parallel to that cut by the handle of the hammer when it fell, and with its face

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[1]One of these hammers was made, through the kindness of Prof. H. Newell Martin, by the mechanic at the Biological Laboratory, the other by Lehman, instrument maker, Baltimore.

looking toward the hammer. The left edge of the plate was vertical, the upper edge horizontal, and the right and lower borders formed an arc whose centre would be cut by a line drawn through the pivots supporting the axis of the hammers. A scale of 90° was engraved on this plate a centimeter from its curved edge, and in such a way that 0° corresponded to the middle of the handle of the hammer when it was hanging in the position determined by the force of gravity.

On the back of this plate and parallel to its surface there swung from an axis, whose centre would be cut by a line drawn through the pivots supporting the axis of the hammer, a heavy strip of brass, *i*, 3.5 mm. thick, 25.5 cm. long and 2.5 cm. wide.

This swinging arm bore on its face a small brass plate, *k*, which had a lip which slightly lapped over the curved border of the plate on which the scale was engraved. This small plate was held in place on the arm by two pins and a thumb screw, *l*, which had its head on the back of the arm. When the thumb screw was screwed home it pressed the lip, like a clamp, tightly down on the border of the large plate at any desired place. This clamp bore on the middle of its face an index, *m*, the point of which was directed to the scale engraved on the large plate and determined the position of the arm.

The free end of the arm terminated in a catch, by means of which the hammer could be held and easily be released whenever it was desired. This catch had the following construction viz.: A heavy block of brass, *n*, was fastened to the end of the arm in such a position that the end of the handle of the hammer which protruded beyond the head would just swing clear of its upper surface. A steel spring forced a small steel catch, *o*, up through a hole in the brass block, so that it projected slightly beyond the surface and obstructed the fall of the hammer by catching the handle where it protruded from the head. The lower part of the block of brass was cut away, so as to make room for a lever, *p*, which had the shape of an inverted L, and which was pivoted at the end of its short arm on the lower end of the catch, and again at the place where the two arms of the L meet, to the solid brass block. By means of this lever the catch could be drawn down and the hammer released.

In all the experiments reported in this paper the subject was reclining, with outstretched leg, (see Fig. 2,) and inasmuch as the ligamentum patellæ was horizontal, the blow was struck with the vertical edge of the hammer. In certain other experiments, in which the subject sat with dangling legs, the ligament held a vertical position and the head of the hammer had to be turned around and its horizontal edge used.

2. *The couch and the supports for the thigh and foot.*[1]—See Plate I, Fig. 2, *a.*)—The following arrangements were made, first, to insure the subject an absolutely comfortable position and freedom from all avoidable reënforcing influences; second, to relieve the quadriceps muscle from the weight of the foot, and so permit its slightest contraction to produce a visible movement.

The man experimented upon lay on his left side, upon a comfort-

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[1]These arrangements were the same as those employed by the writer in a previous research, viz.: "Is the Knee-Kick a Reflex Act?"—*The Amer. Jour. of Med. Sciences,* Jan., 1887.

able couch, so formed as to support the back and head. (See Fig. 2.) The right thigh rested in a splint of plaster of Paris, shaped so as to conform to inner and posterior surface, and of such a height as to hold the right knee on a level with the hip joint. The right foot was supported at the same height by a swing suspended by a long cord from the ceiling.

3. *The recording apparatus.*—(See Plate I, Fig. 2, *b.*)—The amount of the knee-jerk was revealed in the movement of the foot which it produced, and the extent of this movement was automatically recorded.

A long, light but stiff steel rod extended horizontally backward from the awning on which the foot rested, and at right angles to the lower leg. It was fastened to the back of the swing by a ball and socket-joint and it rested, near its free end, in the groove in the circumference of a wheel, which turned so easily as to rotate under the weight of the rod when the latter was pulled forward or pushed backward by the swinging foot.

A steel needle was fastened on the rod at right angles to it, and wrote with its point on a sheet of glazed paper which had been stretched on a board, blackened by the soot of a gas flame, and placed horizontally at a short distance below the horizontal rod. As the foot was jerked forward by the sudden contraction of the quadriceps muscle, following the blow on the ligament, the needle was dragged across the blackened paper and wrote the extent of the movement. As the muscle relaxed again the foot swung back to its original position, *i. e.*, that which was determined by the balancing of the tension of the antagonistic flexors and extensors of the knee.

The under surface of the board on which the paper was stretched was crossed by two parallel grooves, which corresponded to two glass tracks on the little table on which the board rested. After each experiment the board was made to slide a little to one side, so as to bring a fresh surface of the paper under the needle. The mark made by the needle when the board was thus moved recorded the position of the foot when all was quiet and gave a base line from which to measure the extent of the movements of the foot. At the end of the experiments the records thus obtained were "fixed" by being passed through an alcoholic solution of brown shellac, and the distance moved by the foot as a result of each knee-jerk was measured in mm. and tabulated.

In the experiments in which the effect of respiration on the knee-jerk was studied it was necessary that the record should be made on a moving surface, and therefore the blackened paper was stretched on the drum of a Kymographion.

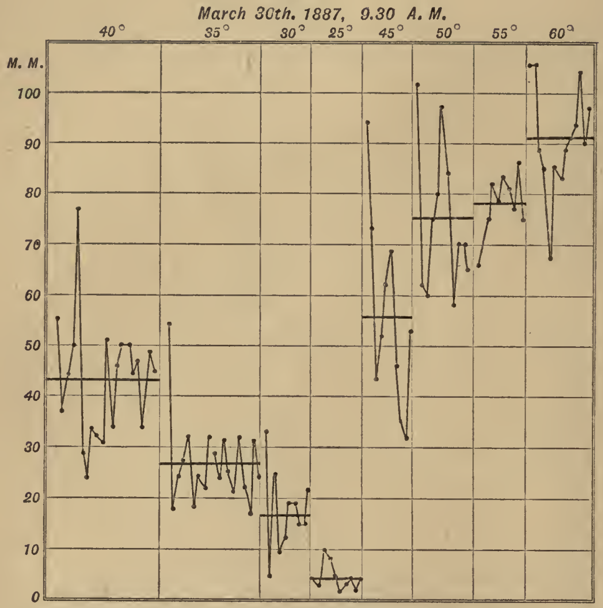
The Experiments.

Effect of successive blows of the same and of different strengths.—The first experiments made with the apparatus described were to determine

how far the extent of the knee-jerk is dependent on the force of the blow. No one who has ever tried to call out the phenomenon can have any doubt that its amount varies with the force of the blow, but in our experiments the closeness of the relation did not at once appear, because we were confronted forthwith by the puzzle which has faced us throughout our work, and which still remains, to a great extent, undeciphered. We found, namely, that if a number of blows of the same force were struck at definite intervals, from exactly the same direction, and on the same part of the ligamentum patellæ, no two of the resulting knee-jerks were of the same extent. Naturally, the sources of reënforcement described by Dr. L. Weir Mitchell and Dr. Morris J. Lewis were looked to for an explanation, but none such could be found. The subject was lying completely at rest in a comfortable position and was conscious of no irritation. His eyes were closed, all the muscles were passive, and the whole body was, as far as possible, in a state of rest. It was then suggested that the force of the blow be increased. This was done, and though similar variations in the extent of the knee-jerk were seen, the movements were found, as a whole, to be greater than before. It was soon ascertained that though blows of the same strength called forth knee-jerks of very different amounts, the averages gained from several groups of twenty or more experiments each, made by striking blows of a certain force, were almost exactly the same, and furthermore, that if the force of the blow was altered, the averages of such groups of experiments made with blows of different strengths, were greater or less, according as the force of the

blow had been increased or decreased. These results will be better understood by reference to Fig. 1.

Fig. 1.



The base line, *o*, shows the position of the recording needle when the leg is quiet, and each of the dots connected by the curve shows, in millimetres, the distance which the foot moved as a result of a blow on the ligamentum patellæ. The experiments which are grouped together show how different may be the extent of the knee-jerks which are obtained by blows which have the same force and which are produced by letting the hammer fall through an arc of the number of degrees given at the top of the table. The heavy horizontal lines which cross such groups indicate the average of the enclosed experiments.

Search for errors in the method employed.—The fact that blows of the same force evoked knee-jerks of very variable extent was, as has been said, an entire surprise to us. The most careful examination failed to reveal any mechanical cause. The hammer fell from exactly the same height and was released in just the same way each time, and as

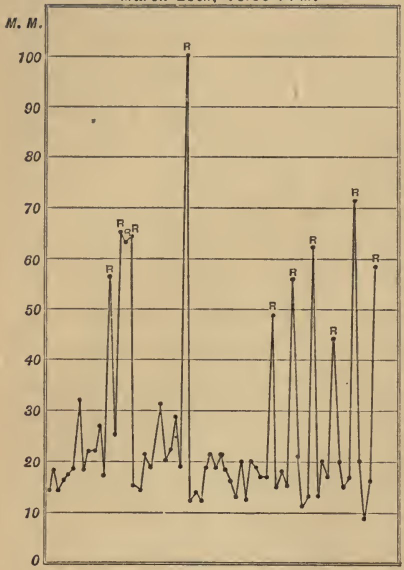
there was no appreciable friction in the apparatus, there could be no doubt that it gave a blow of definite force. The blows were delivered at intervals of fifteen seconds; therefore, the variations could not be due to a wearying of the muscle. Moreover, the knee-jerk was often greater at the end of a series of experiments than at the beginning. The only chance for error seemed to lie in the possibility that the position of the leg was changed slightly from time to time, and that the hammer did not strike the ligament at exactly the same place each time. This question was carefully studied and we were unable to find that there was any such change of position. Moreover, we discovered that it made no appreciable difference in the extent of the knee-jerk whether the hammer struck exactly the middle of the ligament, as we always tried to have it do, or a little above or below that point. Having ruled out all possible sources of error, we were compelled to conclude that the variations which we saw were due to changes which occurred within the individual and which reënforced the action of the mechanisms which produce the knee-jerk. Succeeding experiments proved that there was no lack of reënforcing influences.

The variations seen were compared with strongly reënforced knee-jerks.—Having once assumed that the variations which we had seen were due to some reënforcing influence, we had the curiosity to compare the largest of the knee-jerks, obtained when the subject was entirely quiet, with those which should result from some of the vigorous forms of reënforcement, described by Mitchell and Lewis, such as clinching the hands or clinching the teeth. The results of a few experiments, in

which the reënforcements caused by clinching the teeth were compared with knee-jerks obtained during rest, are shown in Fig. 2. Had a still more active form of reënforcement been employed, probably still greater differences would have been seen. The reënforced knee-jerks, which resulted from voluntarily clinching the teeth, were so extensive as to convince us that the unknown sources of reënforcement, which were continually influencing the knee-jerk, were comparatively weak phenomena.

Fig. 2.

March 29th, 10.00 P. M.



Aim of Experiments of Series I.—It was a great temptation to us to immediately begin to study the effects of different methods of reënforcing the knee-jerk, but we resisted the impulse, knowing that it was much more important to lay a sure foundation for such work by patient and careful study of the extent of the normal knee-jerk when not subject to such exciting influences. We, therefore, determined to make a series of experiments which should last over many days, and which should determine the extent of the knee-jerk in the case of one man who was well, and who was leading his usual regular life. We could not help hoping that in

the course of such experiments many of the more ordinary forms of reënforcement would reveal themselves to us.

Routine of Experiments.—Such a research was accordingly undertaken. The experiments were made on the writer. They extended from April 1st to April 14th inclusive.[1] The condition of the knee-jerk was examined seven times a day, and twenty-five experiments were made at each examination. The hours chosen for the experiments were as follows, viz.: 8.15 A. M., immediately upon rising; 9.15 A. M., soon after breakfast; 1.15 P. M., just before lunch; 2.15 P. M., just after lunch; 6.15 P. M., just before dinner; 8.00 P. M., soon after dinner; and 11 P. M., just before going to bed. For various reasons it was not always possible to make the experiments at exactly the schedule time, but it was seldom that the time of the experiment varied half an hour from that given. The total number of examinations in this series was 93, and the total number of experiments was 2,321. The many experiments which were made at other than the schedule times are not included in these figures.

In the case of each experiment, the hammer was so placed that, when it was hanging free, it just touched the skin over the middle of the ligament. It was then raised through an arc of 40° and allowed to rest on the catch. At the proper moment it was

[1]Throughout the period the subject led a regular life, getting up and going to bed at his usual hours, doing his ordinary work and eating his accustomed fare. It is worth noting that no wine or beer was used during the period, but that a cup of coffee was taken with breakfast and dinner, and a cup of tea with lunch. The subject, as was his habit, smoked one or two cigars a day.

released by a slight movement of the lever, and, inasmuch as it always fell from the same height, it always struck a blow of the same force. The blows were given at intervals of fifteen seconds, and they struck the same part of the ligament each time. For the sake of accuracy all the experiments were made on the bare leg, although examination showed that nearly the same results could be obtained when the knee was covered by a thin layer of clothing. Throughout all the experiments the subject lay with closed eyes, in an absolutely comfortable position, and, as far as was possible, not only avoided all voluntary movements, but directed his thoughts away from the experiment and to some indifferent subject. During the earlier experiments the blows of the hammer were each distinctly felt, but later they were often scarcely noticed, and in many cases the subject went, before the end of the examination, almost, if not quite, asleep.

The following tables give, as far as possible, an accurate account of the experiments and of the condition of the subject at the time that each examination was made. The extent of the movement of the foot resulting from each knee-jerk was accurately measured in millimeters, and tabulated; inasmuch, however, as the reader can be given no correct idea of the subtler influences which governed the extent of each separate knee-jerk, it does not seem profitable to report all these measurements, and only the average of the experiments made at each examination is given. In most cases, indeed, the more delicate influences which determined the extent of the knee-jerk remained undiscovered, but, at times, they unexpectedly revealed themselves, and these discov-

eries give a most interesting and important addition to the physiology of the knee-jerk, and of the central nervous system. These results will be reported by themselves later in the paper.

Explanation of the Tables.—Each table is made in three parts; the first, headed Knee-Jerk, contains the results of the experiments; the second, headed Extracts from Journal, gives, in brief, the way in which the subject spent the day, and, therefore, an idea of his condition at the time of the examination; and the third part, headed U. S. A. Weather Observations, reports the condition of the weather in the morning, afternoon and evening. In the first column of the first part of the table, the time at which the examinations were made are set down; in the second column, the number of experiments made at each time is reported; in the third is recorded in millimetres the average extent of the knee-jerk as determined by these experiments; in the fourth are shown the least and greatest knee-jerks got in the examination, and in the fifth is stated, in the number of degrees through which the hammer fell, the least blow by which a recognizable knee-jerk could be obtained. At the bottom of column two the total number of the experiments made during the day is given; next to this, under column three, is written the average knee-jerk for the day, as determined by the total number of experiments; by the side of this are noted the extreme variations of the knee-jerk obtained on this day with the blow of standard force, *i. e.*, when the hammer fell through an arc of 40°; and, finally, under column five, one is told what was the least blow which was capable, at any time during the day, of producing a visible knee-jerk.

No. 1, Series I—April 1st, 1887.

Knee-Jerk.					Extracts From Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well and Vigorous.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.30 a.m.	25	36	20–48	27°	Just out of bed and half asleep.	7 a.m.	30.150	31°	84	n.	lt. snow
9.45 "	18	88	55–120	20°	Just after breakfast.						
1.15 p.m.	12	111	90–130	20°	Morning spent writing.						
2.15 "	20	68	29–93	23°	Just after lunch.	3 p.m.	30.089	36°	87	n.e.	lt. snow
6.15 "	23	49	10–78	26°	Afternoon spent writing, head tired.						
8.15 "	26	44	16–75	29°	Just after dinner.						
10.30 "	25	45	22–60	30°	Evening spent reading and writing.	10 p.m.	30.036	34°	88	n.	lt. snow
	149	63	10–130	25°		mean.	30.092	34°			

No. 2, Series I—April 2d, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well, but somewhat fatigued by yesterday's work.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.15 a.m.	26	28	12–42	29°	Just out of bed—sleep again (?)	7 a.m.	29.907	34°	89	n.w.	lt. snow
9.45 "	24	72	45–93	26°	After breakfast.						
1.15 p.m.	23	63	31–94	24°	Morning spent writing.						
2.30 "	27	52	26–75	28°	Just after lunch.	3 p.m.	29.789	52°	38	n.w.	clear.
6.15 "	22	23	7–50	35°	Afternoon spent writing—walk an hour.						
8.15 "	27	33	9–62	30°	Just after dinner.						
10.30 "	20	58	37–91	30°	Ev'g spent reading German with friends	10 p.m.	29.941	46°	38	n.	clear.
	169	47	7–94	29°		mean.	29.879	44°			

No. 3, Series I—April 3d (Sunday), 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well, but feel lazy.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
9.30 a.m.	25	40	33–52	25°	Just out of bed; been awake an hour.	7 a.m.	30.093	43°	55	n.w.	clear.
10.15 "	24	64	45–80	26°	Just after breakfast.						
2.15 p.m.	27	39	21–65	28°	Morning spent writing and reading; no hard work done.						
3.30 "	25	74	39–103	25°	Just after dinner.	3 p.m.	29.992	64°	34	s.w.	clear.
6.15 "	27	33	9–61	30°	Immediately upon return from stroll of two hours.						
7.30 "	24	57	27–88	25°	Just after tea.						
10.45 "	26	18	8–30	35°	Evening spent writing and talking.	10 p.m.	29.980	49°	66	w.	clear.
	178	47	8–103	28°		mean.	30.022	52°			

No. 4, Series I—April 4th, 1887.

Knee-Jerk.					Extracts From Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	More rested than yesterday. An enervating day.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.15 a.m.	25	31	7–49	32°	Just out of bed and very sleepy.	7 a.m.	29.928	48°	74	s.	clear.
9.15 "	25	73	43–100	26°	Just after breakfast.						
1.15 p.m.	25	20	6–39	34°	On my feet somewhat—read and talk.						
2.15 "	25	24	7–48	30°	Just after lunch.	3 p.m.	29.724	76°	28	s.w.	clear.
6.15 "	25	27	11–44	36°	Afternoon at laboratory.						
9.20 "	27	21	10–42	37°	An hour after dinner.						
11.00 "	25	22	10–31	37°	A quiet and restful evening.	10 p.m.	29.771	58°	61	n.w.	cloudy
	177	31	6–100	33°		mean.	29.808	61°			

No. 5, Series I—April 5th, 1887.

Knee-Jerk.					Extracts From Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well, but not very energetic.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.15 a.m.	21	19	10–30	35°	Just out of bed and very sleepy.	7 a.m.	29.908	45°	41	n.w.	fair.
9.15 "	25	51	42–60	30°	Soon after breakfast.						
1.30 p.m.	13	27	14–47	32°	Morning spent writing.						
2.30 "	25	43	21–75	27°	Soon after lunch.	3 p.m.	30.019	38°	59	n.w.	cloudy.
6.30 "					Wrote till five, then walked an hour.						
7.45 "	24	57	4–82	29°	Just after dinner.						
10.30 "	27	23	12–41	35°	Walk and make a call ; read aloud.	10 p.m.	30.187	31°	50	n.w.	clear.
	135	37	4–82	31°		mean.	30.038	38°			

No. 6, Series I—April 6th, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimeters.	Extremes.	Lightest Effective Blow.	Well.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.15 a.m.	25	23	12–38	31°	Just out of bed.	7 a.m.	29–332	32°	61	n.w.	fair.
8.30 "	25	51	31–72	27°	Before breakfast and after bath.						
9.30 "	24	79	56–105	25°	Just after breakfast.						
1.15 p.m.	25	49	20–70	27°	Morning spent in making a call and writing.						
2.30 "	26	54	25–82	26°	Just after lunch.	3 p.m.	30–300	48°	26	n. w.	clear.
6.15 "	25	15	7–31	37°	Afternoon spent standing and talking.						
8.00 "	24	32	12–54	30°	Just after dinner.						
11.00 "	24	29	18–55	37°	Evening spent in reading German with friends. At 10.30 the music experiment.	10 p.m.	30.352	41°	39	s.	clear.
	198	47	7–105	34°		mean.	30.328	40°			

No. 7, Series I—April 7th, 1887.

Knee-Jerk.					Extracts From Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimeters.	Extremes.	Lightest Effective Blow.	In morning feel well and vigorous, but become nervous by noon, so that I start easily at noises.	Time.	Barometer.	Thermometer.	Relative Humidity	Wind.	Weather.
8.15 a.m.	26	29	18–38	36°	Just out of bed.	7 a.m.	29.437	38°	60	n.	cloudy
9.30 a.m.	25	71	45–96	22°	After breakfast and an earnest talk.						
1.15 p.m.	24	66	39–92	22°	Morning spent writing—head dizzy.						
2.15 "	25	34	9–57	25°	Just after lunch.	3 p.m.	30.442	50°	34	e.	cloudy
6.30 "	25	31	10–75	30°	Afternoon spent writing; walk half an hour; head and eyes tired.						
8.00 "	25	52	32–72	29°	After dinner and an earnest talk.						
11.00 "	25	32	18–58	32°	Write till ten, then read aloud an hour.	10 p.m.	30.552	45°	60	e.	cloudy
	175	45	9–96	28°		mean.	30.477	44°			

No. 8, Series I—April 8th, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well, slightly tired.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.45 a.m.	25	22	7–40	37°	Just out of bed.	7 a.m.	29.680	41°	66	n.e.	cloudy
9.45 "	25	70	53–87	27°	Just after breakfast.						
1.15 p.m.	28	29	5–87	31°	Wrote a short time; took a walk.						
2.15 "	25	42	17–71	27°	Just after lunch.	3 p.m.	30.566	54°	41	s.e.	clear.
6.15 "	25	44	29–74	22°	Write, call, write.						
8.30 "	28	51	30–72	25°	Just after dinner.						
11.30 "	27	43	22–68	30°	A quiet evening.	10 p.m.	30.536	45°	55	s.	clear.
	183	43	5–87	28°		mean.	30.577	46°			

No. 9, Series I—April 9th, 1887.

Knee-Jerk.					Extracts From Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lighest Effective Blow.	Well and vigorous.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.00 a.m.	26	35	15–50	28°	Just out of bed.	7 a.m.	30.525	39°	80	s.	clear.
9.00 "	25	71	48–100	26°	Just after breakfast.						
1.15 p.m.	26	37	11–72	27°	A busy morning; head and back ache.						
2.15 "	25	36	13–64	26°	Just after lunch.	3 p.m.	30.348	61°	54	s.e.	clear.
6.15 "	25	21	8–49	35°	Afternoon spent writing; walk an hour.						
8.15 "	26	33	15–68	31°	Just after dinner.						
10.30 "	25	14	7–27		A walk; read; evening is close.	10 p.m.	30.276	51°	61	s.	clear.
	178	35	7–100	29°		mean.	30.383	50°			

No. 10, SERIES I—Sunday, April 10th, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.15 a.m.	25	13	6–31	39°	Just out of bed.	7 a.m.	30.212	45°	59	s.	clear.
9.30 "	25	53	30–74	31°	Soon after breakfast.						
1.30 p.m.	25	26	5–71	33°	Church; a short walk.						
3.30 "	26	44	17–76		Soon after dinner.	3 p.m.	30.093	83°	25	n.w.	clear.
7.45 "	16	31	18–52		After a walk of two hours.						
11 "	27	17	6–39	37°	After a quiet evening.	10 p.m.	30.077	65°	48		clear.
	144	31	5–76	35°		mean.	30.127	67°			

No. 11, Series I—April 11th, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well; seminal emission early this morning.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.15 a.m.	25	9	4–27	39°	Just out of bed.	7 a.m.	30.108	61°	49	w.	clear.
9.30 "	25	40	12–56	30°	Soon after breakfast.						
1.15 p.m.	25	23	5–61	35°	Morning spent writing and talking.						
2.30 "	25	41	21–69	30°	Just after lunch.	3 p.m.	30.024	83°	23	w.	clear.
6.15 "	25	27	0–50	33°	Afternoon spent writing.						
8.00 "	26	25	10–57	35°	Just after dinner.						
11.15 "	25	20	9–32	36°	A walk; listen to reading.	10 p.m.	30.097	72°	34	n.w.	clear.
	176	27	0–69	34°		mean.	30.076	72°			

No. 12, Series I—April 12th, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.30 a.m.	27	20	3–42	37°	Just out of bed and very sleepy.	7 a.m.	30.273	58°	67	n.e.	clear.
9.30 "	25	57	38–78	27°	Just after breakfast.						
1.15 p.m.	26	21	9–41	33°	Morning spent standing and walking.						
2.30 "	21	42	25–60	29°	Soon after lunch.	3 p.m.	30.216	65°	52	s.e.	clear.
6.15 "	25	29	6–65	33°	Afternoon at laboratory. On my feet much of the time.						
8 "	25	34	16–71	30°	Soon after dinner.						
12 "	16	10	3–24	33°	Evening with friends. Walk a mile.	10 p.m.	30.253	51°	68	e.	fair.
	165	30	3–78	32°		mean.	30.247	58°			

No. 13, Series I—April 13th, 1887.

Knee-Jerk.					Extracts From Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest Effective Blow.	Well.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.45 a.m.	24	25	11–50	31°	Just out of bed.	7 a.m.	30.295	47°	89	e.	cloudy.
9.30 "	15	74	57–106	22°	Soon after breakfast.						
1.00 p.m.	24	44	25–71	26°	A busy morning.						
2.30 "	25	46	24–69		Soon after lunch.	3 p.m.	30.266	58°	59	s.e.	clear.
6.30 "	25	42	13–74	25°	Afternoon spent writing.						
8.00 "	25	50	27–76	25°	Just after dinner.						
11.00 "	29	20	3–41	33°	Evening spent with friends.	10 p.m.	30.351	46°	64	s.e.	fair.
	167	43	3–106	27°		mean.	30.304	41°			

No. 14, Series I—April 14th, 1887.

Knee-Jerk.					Extracts from Journal.	U. S. A. Weather Observations.					
Time of Examination.	No. of Experiments.	Average Movement in Millimetres.	Extremes.	Lightest effective Blow.	Well.	Time.	Barometer.	Thermometer.	Relative Humidity.	Wind.	Weather.
8.30 a.m.	27	20	7–42	35°	Just out of bed.	7 a.m.	30.317	44°	67	s.e.	fair.
9.15 "	25	53	33–79	20°	Just after breakfast.						
1.15 p.m.	25	42	14–64	24°	Morning spent writing.						
1.45 "	25	41	26–64	25°	After lunch.	3 p.m.	30.184	56°	43	s.e.	clear.
6.30 "	24	16	3–33	34°	Wrote till five; walked an hour.						
8.15 "	25	36	16–64	30°	Just after dinner.	10 p.m.	30.140	49°	65	s.e.	clear.
	151	35	3–79	28°		mean.	30.216	50°			

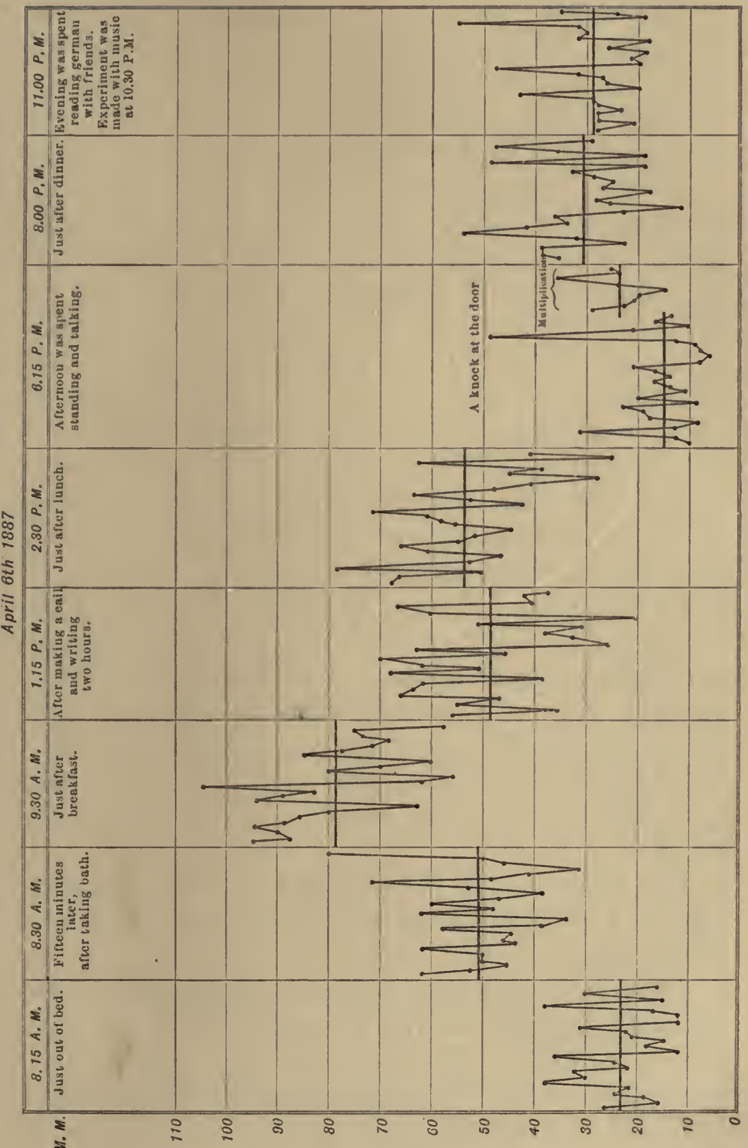
Common experience teaches that when one is well, there are three principal influences which lower the activity of the body: fatigue, hunger and depressing weather; while rest, a meal and invigorating weather increase the activity. One has also learned that even when the general condition is depressed by these influences it may be temporarily roused by any cause of mental excitement, and that when it is in a vigorous state it may be temporarily lowered by drowsiness.

Substitute in the above statements knee-jerk for activity of the body, and they will be equally true. These facts were illustrated in our experiments by a diurnal decline of the knee-jerk, interrupted at meal time, and varied by changes in the weather, fatigue, and by causes of mental excitement.

Explanation of the chart, Fig. 3, which shows all the variations of the knee-jerk which occurred in the course of one day of this series of experiments.— Before studying the results of the experiments as a whole, the writer wishes to illustrate still more clearly the great number of variations to which the knee-jerk is subject in the course of a single day.

The following chart shows the extent of the movement of the foot in millimetres in each experiment taken in the course of one day. All the experiments made at the time of one examination are grouped together under the figures which show the time at which the examination was made. Each dot represents a separate knee-jerk, and the connecting lines are given to enable the eye to more readily grasp the extent of the variations. The heavy horizontal lines show the average of all the experiments through which they are drawn. At the top of the table is given roughly the day's journal, and in the body of the table are remarks accounting for reënforcements, the causes of which were thought to have been recognized.

Fig. 3.


April 6th 1887
8.15 A. M.
Just out of bed.
8.30 A. M.
Fifteen minutes later, after taking bath.
9.30 A. M.
Just after breakfast.
1.15 P. M.
After making a call and writing two hours.
2.30 P. M.
Just after lunch.
6.15 P. M.
Afternoon was spent standing and talking.
A knock at the door
Multiplication
8.00 P. M.
Just after dinner.
11.00 P. M.
Evening was spent reading german with friends. Experiment was made with music at 10.30 P.M.
M. M.
110
100
90
80
70
60
50
40
30
20
10
0

Study of the Chart.—At a glance one sees that, at whatever time the examination was made, the extent of the knee-jerk varied greatly in succeeding experiments. He also notices that the average of the experiments made when the subject was just out of bed, and not thoroughly roused, was low; that in the examination made fifteen minutes later, after the bath had been taken, it was higher; and that an hour later, immediately after breakfast, it was still higher. From this time on, however, the knee-jerk declined, being considerably lower before lunch, and though slightly higher just after lunch, being very much lower just before dinner. After dinner it recovered somewhat, but only to fall again, if but slightly, and at bed time it was very much less than it was just after breakfast, and even less than it was just after the bath taken before breakfast.

To judge from this one day, then, there is a great difference in the extent of the knee-jerk, even in succeeding experiments, and a still greater difference between experiments taken at different times in the day, the knee-jerk being greatest immediately after breakfast, and, in spite of the fact that each meal tends to increase it, being much lower at bed time.

The discussion of the reënforcements which were observed during this day will be deferred until later in the paper.

Diurnal Variation of the Knee-Jerk.—Is the diurnal variation of the knee-jerk seen on April 6th a constant phenomenon? This question is answered by the following table of the averages, compiled from all the experiments which were taken in this series·

Explanation of the Table.—In the first column of the table is given the date of the experiments, and in the first line the hours of the day at which the examinations were made. Beneath the hours, on the same line with the dates, is arranged the average of all the experiments made in the seven examinations of the corresponding day. The table, therefore, enables one readily to compare the results of all the experiments made on each day and of all the experiments made at the same hour on different days. At the bottom of the table, under the hours, is given the average of all the experiments taken at the same hour on all the different days of the series. In addition to this, the table shows the average extent of the knee-jerk for each day; the number of examinations and experiments which were made on each day; and the mean of the barometer and thermometer for each day. Finally, at the bottom of the table, beneath these columns, is placed the average knee-jerk, as determined by all the experiments in the series, and the mean barometer and thermometer for the two weeks under consideration.

Summary of Results of Examinations of Series I.

April, 1887.	8–9	9–10	1–2	2–3	6–7	8–9	10–11	Average K. J. in mm.	Total No. of Examinations.	Total No. of Experiments.	Mean Barometer.	Mean Thermometer.
1st..........	36	88	111	68	49	44	45	63	7	149	30.092	34
2d..........	28	72	63	52	23	33	58	47	7	169	29.879	44
3d (Sunday)	40*	64*	39	74*	33	57**	18	47	7	178	30.022	52
4th..........	31	73	20	24	27	21	22	31	7	177	29.808	61
5th..........	19	51	27	43	..	57	23	37	6	135	30.038	38
6th..........	23	79	49	54	15	32	29	40	7	173	30.328	40
7th..........	29	71	66	34	31	52	32	45	7	175	30.477	44
8th..........	22	70	29	42	44	51	43	43	7	183	30.577	46
9th..........	35	71	37	36	21	33	14	35	7	178	30.383	50
10 (Sunday)	13	53	26	44*	..	31	17	31	6	144	30.127	67
11th..........	9	40	23	41	27	25	20	27	7	176	30.076	72
12th..........	20	57	21	42	29	34	10	30	7	165	30.247	58
13th..........	25	74	44	46	42	50	20	43	7	167	30.304	51
14th..........	20	53	42	41	16	36	..	35	6	151	30.216	50
	25	65	43	47	30	40	27	40	95	2320	30.184†	50°.5‡

*The examination was one hour late.
**The examination was one hour early.
†Mean barometer for April, for 16 years, was 29.995.
‡Mean thermometer for April, for 16 years, was 53.°3.

A little study of the table tells one that the lowest averages were obtained in examinations taken at the beginning and end of each day. Inasmuch, however, as the first examination was made when the subject was just out of bed and still half asleep, while all the rest were made after he had been thoroughly roused, it would seem that the first examination, though of great interest, could scarcely be compared to the rest. Of the six remaining examinations, the one taken immediately after breakfast has, usually, decidedly the largest average. There are exceptions to this rule, however; thus, on April 1st the highest average was got at 1.15 P. M.; on April 3d at 3.30 P. M ; on April 5th at 7.45 P.M; and on April 11th at 2.30 P. M. No cause suggests itself why an exception to the rule should have occurred on April 1st, unless, indeed, some unusual excitement prevailed at the time of the examination. The same may be said of April 3d; this day was Sunday, however, and the change of hours and the absence of hard work in the morning may have influenced the result. On the 5th of April, the disturbing cause was without doubt the weather. The barometer, which was low in the morning, as can be seen by referring to the table of the day, rose, and the temperature fell as the day advanced. Later in the paper it will be shown that such changes are potent influences and always tend to increase the extent of the knee-jerk. With regard to April 11th, it can only be said that the journal reports that there was a seminal emission early in the morning. Whether this fact accounts for the depression of the averages early in the day cannot be definitely decided. In spite of the exceptions noted, it is just to

say that the knee-jerk is generally highest in the early part of the day. This conclusion corresponds with the feeling of the subject, who is usually most vigorous in the early part of the day, but who occasionally does not feel like active work until considerably later.

The last line of the table contains the averages derived from all the experiments taken at each of the regular examinations, arranged according to the hours at which the examinations were made. These averages corroborate what has been already stated, that there is a diurnal variation of the knee-jerk, that it is greatest in the morning, just after the first meal, and that it is lower at night. This falling off of the knee-jerk can be scarcely attributed to anything except a depression of the condition of the body as a whole dependent on weariness, and, as far as the writer can judge, it is proportional to the degree of fatigue, except when counteracted by some reënforcing influences. Although the knee-jerk tends to become less as the day goes on, one sees in the averages given at the bottom of the table, viz.: 25, 65, 43, 47, 30, 40, 27, that the decline is an interrupted one, and this brings us to the consideration of the effect of hunger.

THE EFFECT OF MEALS ON THE KNEE-JERK.—It may be stated, as a rule, that the knee-jerk is higher after each meal than before it. This rule, however, like every other, has its exceptions, and they are shown in the following table :

Explanation of the Table.—In this table the average knee-jerk, before and after each meal, is given, and in the columns following the difference between

these averages is placed under the sign +, if the knee-jerk was greater after the meal, and under the sign —, if it was greater before the meal.

EFFECT OF MEALS UPON THE KNEE-JERK.

DATE.	BREAKFAST.				LUNCH.				DINNER.			
April, 1887.	Before.	After.	+	−	Before.	After.	+	−	Before.	After.	+	−
1st.........	36	88	52	....	111	68	..	43	49	44	..	5
2d..........	28	72	44	....	63	52	..	11	23	33	10	....
3d (Sunday)	40	64	24	....	36	74	38	....	33	57	24	....
4th.........	31	73	42	....	20	24	4	....	27	21	..	6
5th.........	19	51	32	....	27	43	16	....	..	57	..	....
6th.........	23	79	56	....	49	54	5	....	15	32	17	....
7th.........	29	71	42	....	66	34	..	32	31	52	21	....
8th.........	22	70	48	....	29	42	13	....	44	51	7	...
9th.........	35	71	36	....	37	36	..	1	21	33	12	....
10 (Sunday)	13	53	40	....	26	44	18	....	..	31	..	....
11th........	9	40	31	....	23	41	18	....	27	25	..	2
12th........	20	57	37	....	21	42	21	....	29	34	5	....
13th........	25	74	49	....	44	46	2	....	42	50	8	....
14th.... ...	20	53	33	....	42	41	..	1	16	36	20	....
	25	65	40		43	47	4		30	40	10	

From the table, one learns that the knee-jerk was always greater after, than before, breakfast. As has been said, however, this comparison is scarcely just, because the subject was not fully awake at the time of the first examination. One also sees that the average was greater after than before lunch, on nine of the fourteen days studied; that on two more days, the 9th and 14th, there was only the dif-

ference of one mm. between the averages of the two examinations, and that on three days, the 1st, 2d and 7th, the average was considerably greater before than after lunch. With regard to the effect of dinner, one observes that the average was greater after than before dinner on nine of the twelve days on which both examinations were made, that it was only two mm. greater before than after dinner on one of the remaining days, the 11th, and that it was 5 mm. and 6 mm. greater before than after dinner on, respectively, the 1st and the 4th.

As everyone knows, the result of a hearty meal is to make one feel quiet and indisposed to work, while the effect of a moderate meal is to rest and invigorate. If one has been working hard up to the moment of meal time, the tire is at first unnoticed, because the excitement still remains, and it is only after an interval of quiet that one becomes conscious of the weariness. Inasmuch as the activity of the mind has a great influence upon the extent of the knee-jerk, as will be shown hereafter, it is probable that the mental condition is in a great degree responsible for the exceptions which have been noted. An examination of the averages derived from all the experiments taken during the two weeks, before and after the three meals, is to be found at the bottom of the table, and it shows that the knee-jerk was, on the average, always greater after, than before, each of the three meals. It may be justly stated, therefore, that the effect of a meal is to increase the knee-jerk, but that this tendency is not so strong but that it is frequently overcome by counteracting influences.

It may be well to note here that no wine or beer

was used with the meals, but that coffee was taken with breakfast and dinner, and tea with lunch.

EFFECT OF MUSCULAR FATIGUE UPON THE KNEE-JERK.—As has been shown, the knee-jerk, by its diurnal variations, illustrates the gradual loss of vigor which the body, as a whole, suffers from morning till bed time, and the temporary and partial recoveries which it undergoes, as a result of the fresh supplies of nutriment and of rest which it obtains at each meal.

The phenomenon is still more markedly affected by the voluntary exercise of the muscles which are directly concerned in its production. A proof of this statement is offered in the experiments recorded in the following table:

Time of Exam.	Extracts from Journal.	Average Knee-Jerk.
11 A. M.	After writing half hour	71 mm.
11.15 A. M.	After walking up and down stairs 15 min.	28 mm.
11.45 A. M.	After talking earnestly	32 mm.
1 P. M.	After studying curves an hour	44 mm.
2.15 P. M.	Just after lunch	46 mm.

Here one sees that the effect of walking up and down stairs for fifteen minutes was to decrease the average extent of the knee-jerk from 71 mm. to 28 mm. There can be no doubt but that the change was the result of the exercise, for during the next two hours of quiet the average gradually increased, in spite of the fact that hunger and general fatigue must have tended to lower it. Numerous illustrations of the decrease of the knee-jerk, as a result of the voluntary exercise of the muscles of the leg, have occurred in the course of our experiments; thus, we have always found that the phenomenon was markedly decreased by a walk or even a short stroll. This observation is of importance to the

practicing physician, because it teaches him not to expect a vigorous knee-jerk from a patient who has walked a mile to his office.

How far the lessening of the movement seen in such cases is due to fatigue of the muscles which extend the knee, and how far it is dependent on fatigue of the central nervous mechanisms, is a problem, the solution of which would require a special research, which we have as yet had no time to undertake. That the extent of the knee-jerk is intimately dependent on the activity of the spinal centers cannot be doubted, and this dependence probably accounts to a great extent for the diurnal variations which we have called attention to, but it is not at all clear that it is the wearying of the spinal centers which accounts for the low knee-jerk which is found to result from a walk.

Effect of Mental Fatigue.—In our experiments we find that the brain exerts an indirect, but nevertheless very considerable, influence over the extent of the knee-jerk, as will be shown when we come to study the subject of reënforcements. It is rarely, if ever, that the mechanisms of the brain act singly, and consequently it is most difficult to trace the reënforcing influences to their proper source. Apparently, however, it is those centers which are the seat of the will, and of the emotions, rather than those by which we perform such forms of mental work as adding, memorizing and planning, that are chiefly concerned in reënforcing the knee-jerk. In our experiments we have not found that short periods of mental work have any effect on the extent of the knee-jerk, and when the work extended

over long intervals the effects of hunger and of general fatigue disguised the results.

UNUSUAL MENTAL FATIGUE.—Twice in the course of the experiments the subject spent too many hours in measuring and tabulating results, and the work, together with the depressing weather which prevailed at the time, caused unusual mental fatigue. The weariness showed itself in a slight dizziness and an irritability which made him start at unexpected noises. During the experiments which were made at this time the peculiar sensation in the muscle, resulting from the jerk produced by the blow, or from the sudden contraction of the muscle, a feeling which was ordinarily unnoticed became so acute and so disagreeable that toward the end of the examination it was hard for the subject to lie quietly. He had a strong desire to contract the muscles of the limb and foot of the side experimented upon, the feeling being comparable to that which one has in the muscles of the jaw after biting a piece of rubber hard. The more one thought of it the stronger became the temptation to move, until it seemed to the subject as if he were keeping quiet by a positive act of the will. This nervous desire to contract many muscles of the limb was suggestive of a central rather than a peripheral excitability, and at first thought was referred to the spinal cord. The idea suggested itself that the brain was weary and was therefore unable to exert the inhibiting influence which many suppose it to have over the centres of the cord, and that these centres being partially freed from control, were unusually active. The subject found, however, that by directing his thoughts away from the experiments and to other subjects, by compelling himself to give

his whole attention to planning an apparatus, for instance, he could, after a little time, forget the irritating sensation. When the thoughts were thus engaged on other matters, it would seem that the spinal cord would be more free from cerebral control than when the mind was wholly interested in the knee-jerk, and yet the disagreeable sensation and the exaggerated movements ceased, which proved the excitability to be in the brain rather than in the cord. It was never found during this research that it was possible to inhibit the extent of the knee-jerk by an act of the will, but the subject noticed again and again that when the knee-jerk was being reënforced by unusual cerebral activity, especially if of an emotional character, the extent of the movement could be reduced by directing the thoughts to some indifferent subject, for instance, by quietly concentrating the attention on the warmth of the skin of the hand.

As far as the writer can judge, from his experiments, fatigue, whether bodily or mental, is accompanied by a decrease of the knee-jerk, and the exceptions recorded above, when excessive mental weariness was found to increase the extent of the phenomenon, was due to the fact that the mind was in an irritable condition, and reënforced the knee-jerk. This matter will become clearer after a review of the ways in which the knee-jerk can be reënforced.

[Since the above was written the attention of the author has been called to a short article by Maximilian Sternberg, in the Centralblatt für Physiologie, May, 1887, in which the writer relates his experiments, and states his conclusion that an increase of the tendon reflex is a sign of general fatigue, whether produced by long-continued physical or mental exertion, and explains the fact as possibly resulting from the withdrawal of cerebral inhibition. This result is the opposite of that reached by the author of this

paper. The apparent contradiction, however, may be explained by the fact that Sternberg's experiments dealt with cases of extreme fatigue, while those of the author were confined to a study of an amount of fatigue such as would ordinarily occur in the course of a day. The whole subject of the effect of different kinds and of different degrees of fatigue on the knee-jerk, is worthy of further study.]

REËNFORCEMENTS OF THE KNEE-JERK.—As has been said, successive blows of the same force, delivered at like intervals, and on exactly the same part of the ligamentum patellæ, called forth knee-jerks of different strengths. Since the stimulus was the same in each case, the causes of the variations must be sought within the individual. It immediately suggests itself, that it is possible that the irritability of the muscle is continually undergoing change. When one, however, considers how equally a muscle which has been separated from the influence of the central nervous system, by division of its nerve, responds to like stimuli, he is forced to admit that the variations in the knee-jerk must result from changes originating outside of the muscle, and, most probably, in the central mechanisms with which it is connected. If the knee-jerk be a reflex act, as many suppose, its variations may well be due to alterations in the activity of the reflex centers of the cord; if it be a peripheral act, it may be that the variations are dependent on changes in the tension of the muscle, resulting from changes of activity of the centers of the spinal cord, which are thought to control its tonus. In fact, whatever the nature of the process resulting in the knee-jerk, one must look to the centers of the spinal cord as the source of the variations which have been noticed. What are the influences which determine the activity of these centers? It is wisest

to not try to answer this question, and to attack the subject from another side.

As has been said, it was not the object of our research to determine the causes of the reënforcement of the knee-jerk, but we soon found that we could not study the subject at all without taking this question into consideration. It is not too much to say, that every knee-jerk which one obtains, is the resultant of a vast number of reënforcing influences, which are for the most part unrecognizable, but which occasionally reveal themselves, though singly, when some source of reënforcement is so active as to attract attention.

REËNFORCEMENT CAUSED BY IRRITATION OF THE SKIN.—For instance, a sensory irritation, such as a prickling or itching of the skin, causes a marked reënforcement. Thus, at the examination at 6.30 P. M., April 5th, the average knee-jerk was 14 mm., and the reënforcement which resulted from a blow which chanced to be given at the moment when the ear itched was 63 mm. (Fig. 4.) Again, at the examination at 12 P. M., on April 12th, the average knee-jerk was 13 mm., and itching of the skin caused a group of reënforcements, viz: 37, 14, 25, 25, (Fig. 5.) With regard to the extent of the reënforcements, one must remember that even when an irritant is con-

Fig. 4.

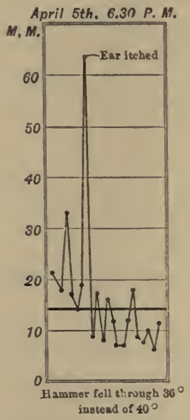
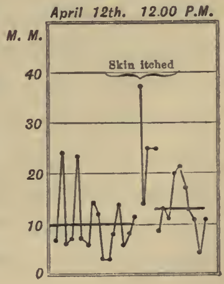


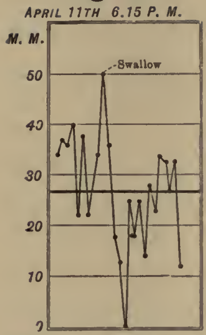
Fig. 5.



tinuously applied, we recognize the sensation, not as constant, but as of varying intensity, and that Mitchell and Lewis found that the extent of the reënforcement depended upon the moment at which the blow was delivered. If the blow falls at the moment that the reënforcing influence is at its height, the resulting movement is more marked than if the knee-jerk is called out a little earlier, or a little later. Thus, in the second example given, the skin was itching all the time, but the intensity of the sensation was much greater at one moment than at another, and the reënforced knee-jerks show a similar difference. The above examples illustrate a fact which was demonstrated many times in the course of our experiments. It was noticed, again and again, that not only such a positive source of irritation to the skin, but anything causing discomfort, as, for instance, a crease in the clothing, or an uncomfortable position, was sufficient to increase the extent of the knee-jerk. These observations corroborate the results of Mitchell and Lewis, who found that painful impressions brought to the skin, as heat, cold, the electric wire brush, etc., were capable of reënforcing the knee-jerk.

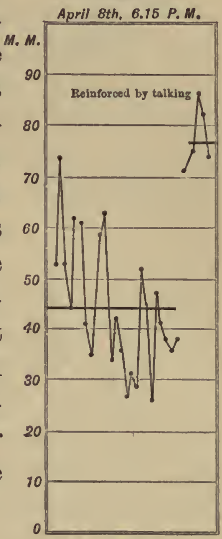
Reënforcements Produced by Voluntary Actions. Mitchell and Lewis also found that any voluntary movement, however slight, tended to reënforce the knee-jerk, and in our experiments we saw this fact illustrated over and over again. Thus at the examination at 6.15 P. M., on April 11th, the average knee-jerk was 27 mm., and the movement which resulted from a blow which chanced to fall at the moment the subject was swallowing, was 50 mm.

Fig. 6.



(Fig. 6.) Again, at the examination at 6.15 P. M., on April 8th, the average knee-jerk was 44 mm., and the knee-jerks which were called out immediately after the regular experiments and which were reënforced by talking, measured 71, 75, 86, 82 and 74 mm. (Fig. 7.) As has been said, to get the full effect of the reënforcement, the blow must be delivered at just the right moment after the reënforcing act. When this was done, such active reënforcing acts, as clenching the hands or teeth, enormously increased the movement. (See fig. 4.)

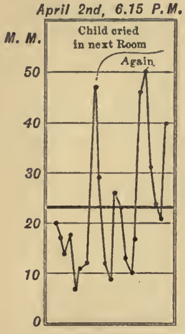
Fig. 7.



REËNFORCEMENTS PRODUCED BY EXCITING THE ATTENTION.—All these reënforcing influences were of interest to us chiefly because of our wish to avoid them, and our desire to see blows of the same force call forth knee-jerks of the same extent. When the subject was lying entirely quiet, with closed eyes, in what he felt to be an absolutely comfortable position, the knee-jerks continued to be of variable extent. A cause for some of these variations was, however, soon discovered. During the examination at 6.15 P. M., April 2d, a child in the next room began to cry, but was immediately quieted; in a few moments the child began to cry again and was again quickly quieted. The average

knee-jerk at this examination was 23 mm., and the movement which occurred while the child was crying were 47 mm. and 46 mm. (Fig. 8.) The subject of the experiments was in no way interested in the child and was not conscious of making the slightest movement while it was crying.

Fig. 8.

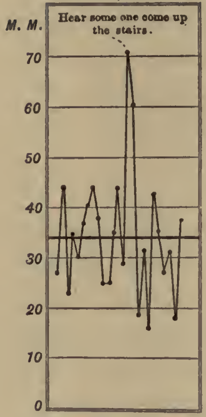


Three explanations of the reënforcement suggested themselves: One, that the subject had, without knowing it, made a voluntary movement; another, that the sound had acted like other forms of sensory stimulation, which have been found to reënforce, and, finally, that it was possible that the cerebral processes, which accompany the turning of the attention into new channels had, in some way, influenced the action of the distant centres in the cord which control the extent of the knee-jerk.

When the attention of the subject had once been turned to studying the action of his mind, he began to recognize that the activity of his thoughts was not without an influence on the extent of the knee-jerk. It was soon noticed that noises which were not loud, and which could be only very weak sensory irritants, if of a kind to attract the attention, increased the extent of the phenomenon, while much louder sounds, if devoid of interest, had no appreciable effect. Thus, during the examination at 8 P. M., April 12, when the average knee-jerk was 29 mm., some one was heard coming up stairs, and the knee-jerks, which happened to be taken at the time,

Fig. 9.

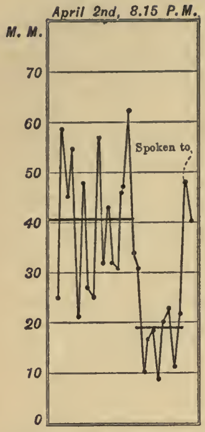
April 12th, 8.00 P. M.



were 71 mm. and 60 mm. (Fig. 9.) At the same time, the rattling by of carts, an accustomed sound, and one devoid of interest, had no appreciable effect. It was soon found that if the subject were spoken to, if a knock came at the door, or if in any other way the attention of the subject were attracted at the moment that the blow was struck, the knee-jerk was markedly increased.

EFFECT OF CEREBRAL INACTIVITY AND OF SLEEP. If the sudden awakening of the attention was capable of increasing the knee-jerk it might seem as if a quieting down of cerebral activity would produce the opposite effect, and this appeared to be the case. Not infrequently the average of the experiments at the beginning of an examination, when the mind of the subject, who had perhaps just stopped working, was in an active state, was considerably higher than the average of the experiments which were made toward the close of the examination, when quiet, or even a condition closely resembling sleep, had crept on. It is, perhaps, worth noting that the subject has always had the faculty of going to sleep at short notice, and that the jars caused by the regular blows of the hammer ceased to attract his attention after a few hundred experiments had been made upon him. The effect of the quieting down of the cerebral mechanisms was illustrated in the examination at 8.15 P. M., April 2, when the average of the first fifteen experiments was 41 mm. and the average of the next

Fig. 10.

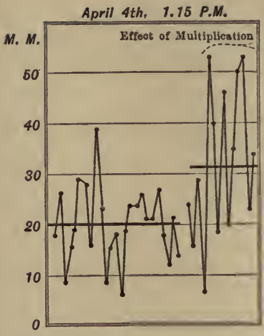


ten experiments was 19 mm. The next two blows were struck just after the subject had been spoken to, and the knee-jerks were 48 mm. and 40 mm. (See Fig. 10; see, also, Fig 9 and Fig. 6.)

Effect of Different Forms of Cerebral Activity.—The experiments which we made with reference to the effect of different forms of cerebral activity were far too few to offer a basis for positive conclusions, but it seemed to us that it was the emotional forms of activity which had the greatest influence on the process. Thus, in the case of mental arithmetic, the simple act of multiplying two numbers, even if they were difficult, did not seem to affect the knee-jerk especially, unless the endeavor was made to obtain the result as quickly as possible and the subject were excited by the attempt. The question is worthy of an especial research. One great difficulty in such a research arises from the fact that the experimentor cannot time the blow so as to get the knee-jerk at the moment when the mind of the subject is most actively employed. It is possible that such experiments might be combined with plethysmographic experiments to advantage.

Effect of Multiplication.—At the examination at 1.15 P. M., April 4th, we tried the effect of multiplication. The average knee-jerk at the time was 20 mm., while the average during the period

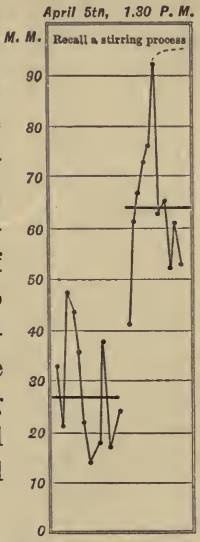
Fig. 11.



when the subject was rapidly multiplying, was 32 mm. (Fig. 11.)

REËNFORCEMENT CAUSED BY EXCITING MENTAL WORK.—A good example of the effect of exciting mental work is to be found in the results of the examination at 1.30 P. M., April 5th, when the subjet repeated to himself Browning's stirring poem—"How they Brought the Good News from Ghent to Aix." The average knee-jerk during the preceding quiet had been 27 mm., and the average taken while the poem was being recalled to memory was 64 mm. (Fig. 12.) In such a case as this, one cannot help thinking that the muscles of the larynx may have been called into play, and that the rhythm of the respiration may have been altered. The subject was not conscious of making any attempt at phonation, but it did seem to him that his breathing had been longer and deeper.

Fig. 12.



EFFECT OF RESPIRATION ON THE KNEE-JERK.—It is interesting to consider, in this connection, the effect of the respiration on the knee-jerk. A few experiments were made with reference to this point, the respiration and the knee-jerk both being recorded on the same moving surface. It was not found in these experiments, however, that the res-

piration had any effect upon the phenomenon. It seemed to make no difference whether the blow fell at the beginning, middle or end of inspiration, or at the beginning, middle or end of expiration. In fact, as far as these experiments gave information, the regular acts of respiration do not reënforce the knee-jerk.

RENËFORCEMENT PRODUCED BY ASPHIXIA.(?)—The following experiments show that the knee-jerk is not altered by slight changes in the respiratory rhythm, but that it is increased by violent respiratory movements, or the causes which produce them. In the examination made at 8.30 P. M., April 8th, the average knee-jerk was 51 mm. The following experiments were made fifteen minutes later, and in just the same way, except that the blows were delivered at intervals of ten, instead of fifteen seconds, the usual rate. The figures show, as in all other cases, the extent of the movements of the foot, resulting from the knee-jerk, in millimetres.

During quiet—35, 29, 55—a deep inspiration is taken, and the breath is held for seventy seconds—41, 44, 45, 49, 55, 72, 100—breathe again, and at first very hard—72, 57, 61, 42, 41, 52, 41, 32—another deep inspiration taken, and held seventy seconds—56, 58, 67, 70, 78, 79, 89—breathe again, and heavily—80, 59, 64, 56, 41, 30.

The first time the breath was held, more than forty seconds elapsed before a material increase in the extent of the knee-jerk was seen, but during the next thirty seconds, when the endeavor to keep from breathing had become painful, the increase in the knee-jerk was very marked. As soon as the subject

began to breathe again the irritation began to pass off, and the movement to become less, and in about forty seconds it had got back to its normal average.

When the breath was held the second time, the increase in the knee-jerk came much sooner, and as in the first case, the extent of the movement increased as the feeling of oppression increased. As in the previous case, it required about forty seconds after breathing had begun again, for the knee-jerk to get back to its normal amount.

How far the increase in the phenomenon seen in these experiments was due to the pain, and how far to the effects of temporary asphixia upon the central nervous system, is difficult to say.

Similar results were got when the breath was, as far as possible, expelled and kept out. During quiet—52, 41, 47, 46, 41—breath expelled and kept out—65, 80, 85, 99—breathe again—72, 80, 60, 69, 63, 67, 44. This was a much more painful experiment, and the effect of the lack of air was perceptible almost at once in the increase of the knee-jerk. At the end of forty seconds the pain was so intense as to bring tears to the eyes, and even after the breath was taken again, the painful feeling referred to the lower part of the chest lasted for some time. It is noticeable that in this case the knee-jerk returned to the normal more slowly than in the previous experiments.

These experiments are recorded here not because any definite conclusion can be drawn from them alone, but because they are suggestive, and because they illustrate one more of the many sources of reënforcement of the knee-jerk. Whether they should be grouped with reënforcements which result

from painful sensory impressions, from voluntary actions, from emotional activity, or from functional disturbance of the spinal centers, is hard to say, since all these causes seemed to take part in producing the result.

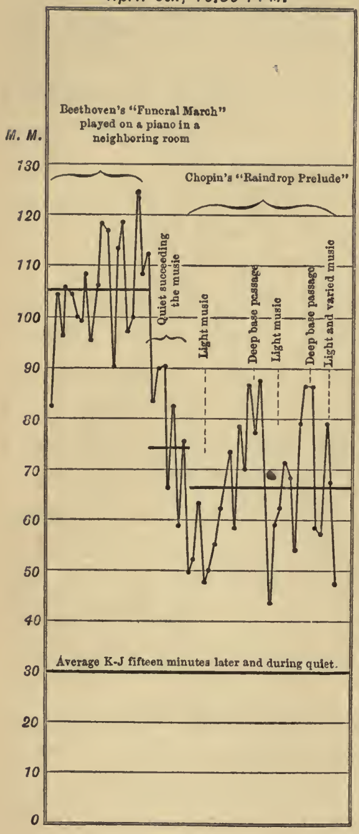
Reënforcement of the Knee-Jerk Caused by Music.—Perhaps the most interesting of all the forms of reënforcement attributable to cerebral action, which we saw, was that produced by music. Not all forms of music have this power, however, and, as far as we have been able to judge, it is confined to such as are capable of exciting an emotional interest. For instance, the writer can state that "Beautiful Spring," when played by a hand-organ, has little or no effect upon his knee-jerk, although a good military band, when playing a stirring march, is able to cause a very decided reënforcement.

One day during the experiments a procession passed the end of the street, a short distance away, and the effect of the music was very evident. The twenty-five experiments of the examination which had just been made had shown the average knee-jerk to be 32 mm. At the approach of the procession the subject resumed his place on the apparatus, but the first blow was not struck until the first band was passing the end of the street—60, 71, 74, 70, 60, 55—another band immediately followed, and it began to play "My Maryland" just before it reached the street—62, 76, 76, 74, 71, 66, 59, 64, 59—this was followed by a drum corps—48, 55, 51, 55, 53, 49, 52—and then the music died away in the distance and only the ordinary street sounds remained—40, 45, 37,

30, 39, 53, 37, 29. The increase and decline of the knee-jerk as the music approached and died away, and the difference in the effect of the bands, the drum corps and the street sounds, is very interesting. The fact that the character of the music determined its power to reënforce the knee-jerk was still more clearly illustrated in an experiment made on April 6. The average knee-jerk at 8 P. M. was 32 mm. and the average knee-jerk at 11 P. M. was 29 mm. It is fair to assume that at 10.30 P. M., the time of the experiment, the average knee-jerk during quiet would not have been far from 30 mm. The music used in this experiment was a good piano in a neighboring room, played by a skillful pianist. While Beethoven's "Funeral March" was being played the knee-jerks were, viz.: 82, 104, 96, 105, 104, 99, 108, 95, 106, 118, 117, 90, 113, 119, 97, 100, 124, 108, 112, and the average was 105. This was followed by an interval of quiet, during which the knee-jerks fell off—83, 90, 90, 66, 82, 59, 75, 50; average, 74. Then Chopin's "Raindrop Prelude" was played, and to our delight, when we came to read the results we found that the extent of the knee-jerk had varied with the character of the music in the most remarkable manner. Thus, during the soft music, when the raindrops are supposed to be falling, the knee-jerk was 52, 63, 47, 50, 55; as the music changed and the deeper passages began to make themselves felt, it was 66, 73, 58, 78, 70, 86, 77, 87; as the music subsided and became softer the measurements were 66, 43, 59, 62, 71, 68, 54; as the more thrilling passages succeeded 79, 86, 86 was measured, and finally, as the varied but softer parts came again, the knee-jerk was 58, 57, 79, 67, 47. As has been said, the average of the knee-jerk during

Fig. 13.

April 6th, 10.30 P. M.



quiet, as found by twenty-five experiments taken a short time after the subject had quieted down, was 29 mm. (See Fig. 13.)

Perhaps the reader is inclined to doubt that music could have had such an effect, and may wonder, as did the writer, whether it were not possible that the subject of the experiments had unconsciously favored, or, perhaps, even almost manufactured the results. That this was the case, however, scarcely seems probable, because the subject was never sure during the examinations of the extent which his foot moved, excepting to know that the movement was slight or was considerable, and he was unaware of the closeness with which the knee-jerks had followed the music until he saw the curves after the experiments were over. Had this been the first set of experiments which had been made on the subject it is probable that he would have been much more interested in the blows of the hammer than in the music, but as this was the sixth day of the series, and as his knee had been struck more than a thousand times during

the week, he was able to forget the blows of the hammer and to think only of the music.

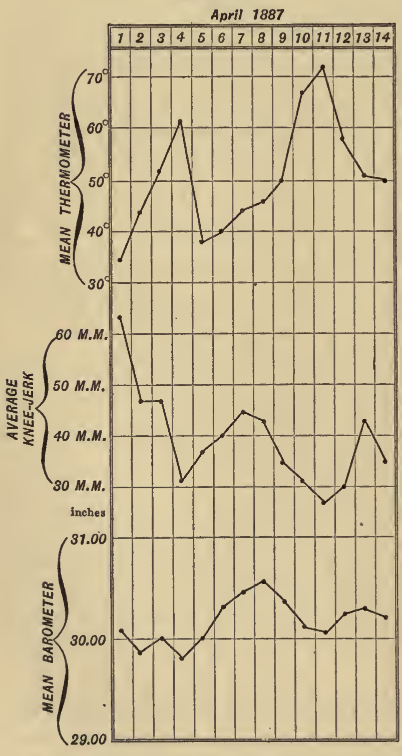
Reënforcements Produced by Exciting Dreams. The fact that the amount of the knee jerk is largely dependent on the activity of the cerebral centers, which are the seat of the emotions, has received another and curious illustration in the course of our experiments. As has been said, the subject, when tired, not infrequently dozed off toward the end of an examination, or, at least, so far lost consciousness that he became no longer responsible for his thoughts. Thus, it not infrequently happened that he pictured himself as kicking a football, or straining to lift a heavy weight, or steadying himself to aim a pistol, or as performing some other vigorous action, and if, as was not seldom the case, the blow on the ligamentum patellæ was struck at such a moment, he was recalled to himself by the unusual violence of the resulting knee-jerk. This was not a single experience, but happened many times, so that the subject had no doubt of the correctness of the observation.

Even during sleep, then, cerebral activity is making itself felt throughout the body. This fact scarcely needed a proof, for every one has noticed the running movements of sleeping dogs, etc. It is interesting in this connection, however, because evidence thus obtained is much more trustworthy than any which could be gained during waking hours, when the subject might be thought unintentionally to help to bring about the results.

Influence of the Weather Upon the Knee-Jerk. —In the course of the experiments the subject noticed that his general condition and his knee-jerk were be-

coming less vigorous and attributed the change to the fact that the weather was becoming warmer. The first warm spring days give most men a feeling of lassitude, and the subject knew that he was no exception to the rule. One's sensations are unreliable data, unless corroborated by more substantial evidence, and it seemed worth while to compare the recorded variations of the knee-jerk with the variations of the temperature during the two weeks. The U. S. A. weather observations were accordingly consulted, and it was found that, in general, as the temperature increased the knee-jerk became less. The correspondence was not so close, however, but that it was evident that other influences were at work, and it occurred to the writer that the barometric changes of the atmosphere might be of importance in this connection. How greatly the extent of the knee-jerk is influenced by thermometric and barometric changes can be best understood by study of Fig. 14.

Fig. 14.



Explanation.—At the head of the chart is written the dates on which the experiments were made, and at the left side the

Farenheit thermometer scale from 30°–70,° a scale of millimetres, to show the extent of the knee-jerk, and the barometer scale from 29–31 inches. The curve opposite the thermometer scale shows the variations of the temperature, each of the dots connected by the lines giving the mean temperature for the corresponding day. The curve opposite the millimetre scale shows the variations of the knee-jerk, each dot representing the average of all the experiments taken on the corresponding day. Similarly the curve opposite the barometer scale records the variations of the barometer, each dot giving the mean of the barometer for the corresponding day.

STUDY OF THE DIAGRAM.—The correspondence between the temperature and the knee-jerk curves is not very accurate, but one sees that on the 4th and 11th, when the temperature was high, the knee-jerk was low, while on the 1st, 7th and 14th, when the thermometer was much lower, the knee-jerk was considerably higher. In general, then, as the temperature rises, the knee-jerk becomes less, and as the temperature falls, the knee-jerk becomes larger.

If now one compares the knee-jerk and barometer curves, he finds the agreement to be much closer. The barometer fell, roughly speaking, from the 1st to the 4th, so did the knee-jerk; the barometer rose from the 4th to the 8th, so did the knee-jerk; the barometer fell from the 8th to the 11th, so did the knee-jerk; the barometer rose from the 11th to the 13th, so did the knee-jerk; and finally, the barometer fell from the 13th to the 14th, and so did the knee-jerk. In general, then, it may be said that as the barometer rises and falls the knee-jerk rises and falls.

A more careful examination, however, shows that though this general correspondence existed, the two did not agree in the extent of their variations, nor did they vary in just the same way from day to day. Thus the knee-jerk fell markedly from the 1st to

the 4th, and the barometer fell only a little; moreover, the barometer rose from the 2d to the 3d, while the knee-jerk was stationary. Again, one sees that the knee-jerk fell off from the 7th to the 8th, although the barometer was still rising. These differences can only be understood by simultaneously comparing the three curves, and remembering that a rise of temperature or a fall of the barometer tends to depress the knee-jerk, while a fall of temperature or a rise of the barometer tends to elevate the knee-jerk curve.

From the 1st to the 2d the temperature rose and the barometer fell, and both of these influences acted to lessen the movement; from the 2d to the 3d the temperature continued to rise and the barometer rose, and the counteracting influences caused the knee-jerk to remain stationary; from the 3d to the 4th the temperature rose and the barometer fell, and the knee-jerk curve consequently fell very low; from the 4th to the 5th the temperature fell markedly and the barometer rose a little, and the knee-jerk began to recover; from the 5th to the 7th the barometer rose markedly, and the slight rise of temperature which occurred, not being sufficient to counteract its influence, the knee-jerk curve rose; from the 7th to the 8th the continually increasing temperature began to make itself felt, so that the process became less active, in spite of the fact that the barometer continued to rise; from the 8th to the 11th both the temperature rose and the barometer fell, so that the knee-jerk was greatly depressed; from the 11th to the 13th the temperature fell and the barometer rose, and both influences assisted to restore the knee-jerk; from the

13th to the 14th, however, the barometer began to fall again, and the temperature being nearly stationary, the knee-jerk was again depressed.

These curves show most clearly that the knee-jerk is closely dependent on changes in the weather, but, inasmuch as we are something more than weather-gauges, the variation is qualitative rather than quantitative. The fact that other influences are at work is shown in the course of the curve of the knee-jerk, when looked at as a whole. Thus one observes that the general condition of the subject, when looked at from this standpoint, was falling off during the two weeks, in spite of the fact that the barometer was, on the whole, rising: moreover, this depression of the knee-jerk would seem to be greater than the rise of temperature, which occurred during this time, could account for. The fact is easily explained; the work involved in the research and in the study of the records gained in the experiments was not small, and the fatigue which the subject felt at the end of the fortnight was an undoubted element in causing the marked falling off of the knee-jerk.

It is no new discovery that the general condition of man is greatly influenced by changes of the weather, but a demonstration of the fact is nevertheless valuable and may perhaps drive home the lesson already learned by physicians and surgeons in their practice.

It naturally suggests itself that what we call the weather is composed of other conditions beside those recorded by the thermometer and the barometer, and that the direction of the wind, the degree of humidity of the air and the electric potential of the atmosphere

may well have an influence upon man. There can be no doubt but that the degree of the humidity of the atmosphere influences us greatly by determining the evaporation of the perspiration from the skin, but that we are influenced by the electrical condition of the atmosphere is by no means as certain. One knows so little concerning the electrical changes of the air that the subject is always an attractive theme for speculation, and one is in the habit of holding it responsible, in a vague sort of way, for many peculiar feelings which he cannot otherwise explain. The idea is a popular one and even finds its way into the novel of the day. Thus, one reads: "I hastened to do as I was asked, the more readily as, what with fear and horror, and the *electric tension* of the night, I was myself restless and disposed for action."[1]

Plate II was constructed to enable one to readily compare the variations of the knee-jerk with the changes which all the different components of the weather underwent at the same time.

The study of the electrical condition of the atmosphere is a difficult one and requires the use of special appliances. The writer could, therefore, scarcely have gained any information on this point had it not been for the kindness of Mr. Park Morrill, who was making a special study of this subject near by, at the Johns Hopkins University. The curve of the electric potential of the atmosphere given in the chart is based on Mr. Morrill's figures, which state in volts the electric potential of the air as compared with that of the earth, regarded as 0.

Explanation of Plate II.—On the first line, at the top, are given the dates, and beneath them the hours of the day, from 7 A. M. to 11 P. M.

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[1] The Merry Men, by R. L. Stevenson.

The first curve of the chart shows the diurnal variations of the knee-jerk as determined by seven examinations. The average of all the experiments made at each examination is represented by a dot, placed at the proper height with reference to the millimetre scale, at the left side of the chart, and under the day and hour at which the examination was made. The lines connecting the dots enable the eye to readily follow the variations of the knee-jerk during each day. The larger dots represent examinations which were made directly after a meal.

On the base line of this knee-jerk chart is recorded the direction of the wind in the morning, afternoon and evening of each day.

Below are arranged, in order, the curves which show the variations of the barometer, the thermometer, the electric potential of the air, and the relative humidity of the atmosphere. Each dot in each of these curves represents a separate observation, and is placed at a height corresponding to the scale at the side of the latter, and under the hour at which the observation was made.

The heavy cross lines show the average knee-jerk for each day, and the mean of the barometer, of the thermometer, and of the electric potential of the air for April, as determined by the observations of a number of years.

Study of Plate II.—It seems to the writer that this chart is of great value from the negative evidence which it offers. It shows that a change in the direction of the wind, a change in the electric potential of the atmosphere, and slight changes in the relative humidity of the air, are without visible influence upon the knee-jerk, and, presumably, upon the central nervous system. It also calls the attention to the fact that the variations of the barometer and the thermometer, though of the greatest importance in determining the height of the daily average of the knee-jerk, are secondary to hunger and fatigue in their effect upon its hourly variations.

Summary of Results of Experiments of Series I.—The extent of the normal knee-jerk is continually undergoing change. So great are the variations, even when the subject is at rest, that a correct idea of the activity of the process can be gained only by averaging the results of twenty or more experiments. The average knee-jerk varies in amount at different

times of day, being as a rule greatest in the morning, soon after breakfast, and being very much less at night. The decline which occurs as the day advances is very irregular, but, in general, the knee-jerk is larger after each meal. Finally, the extent of the knee-jerk may differ greatly on different days.

The causes of these variations of the knee-jerk are not only alterations in the muscles and nerves involved in the process, but, to a still greater degree, changes in the activity of the central nervous system, either as a whole or in part. Thus fatigue, hunger, enervating weather and sleep, conditions which decrease the activity of the whole central nervous system, decrease the average knee-jerk, while rest, nourishment, invigorating weather, and wakefulness, influences which increase the activity of the central nervous system, increase the average knee-jerk. These influences account for the diurnal variations of the knee-jerk, while the multitude of changes that are seen to occur within short intervals of time are due to temporary alterations in the activity of certain parts of the brain and cord. Thus voluntary movements and strong emotions, when synchronous with the blow, are found to increase the movement; and this is noticed even during sleep when the dreams are vivid. Similarly, sensory irritations, even when not strong enough to produce visible reflex actions, may markedly reinforce the knee-jerk, but whether on account of their effect upon the brain, or upon the spinal cord, must be proved by future experiments.

Inasmuch as the normal respiratory movements and quiet thought were not seen to influence the process, it seems probable that the action of the many

mechanisms of the central nervous system, except when very strong, is not accompanied by the development of reënforcing influences; this is far from certain, however, and, inasmuch as the origin of but few of the more delicate reënforcing influences were discovered, this interesting question must be left open to future study.

In general, then, it may be said that the knee-jerk is increased and diminished by whatever increases and diminishes the activity of the central nervous system as a whole, and that it is even more noticeably altered by temporary changes in the activity of certain mechanisms of the spinal cord and brain.

In the experiments described in this paper it was found that the movements of the foot, caused by knee-jerks that were produced by the usual blow, *i. e.*, when the hammer fell through an arc of 40°, varied from 0 millimetres to 130 millimetres. Still greater movements would undoubtedly have been seen had vigorous reënforcements occurred at the time when the average knee-jerk was higher. The average movement gained from the results of the 2,320 experiments of this series was forty millimetres. The least blow which was seen to produce a movement of the foot was obtained by letting the hammer fall through an arc of 20°.

The Results of Experiments of Series II.

The results of the experiments of Series I were so remarkable that it seemed to the writer that he ought not to publish them without assuring himself of their correctness. He accordingly undertook a second series of experiments, which extended like the first over two weeks, and which differed from

them only in this: that nine instead of seven examinations were made on each day. The two extra examinations were made, the one between eleven and twelve o'clock in the morning, the other, between four and five o'clock in the afternoon. These experiments were made with all the care that was given to the previous series, but it seems unnecessary to publish the results in detail. Suffice it to say that the conclusions reached in the second series of experiments corroborated those which were obtained in the first series in every particular. There were the same extraordinary variations in the extent of the knee-jerks produced at intervals of only a few seconds. The average knee-jerk was found to be highest soon after breakfast, and to be low at night, and it was seen to be higher after than before each meal. The extra examinations, made in the middle of the forenoon and afternoon, showed, moreover, that the average knee-jerk gradually fell throughout the forenoon and throughout the afternoon, unless some unusual counteracting influence prevailed. It was also found that the average knee-jerk changed from day to day, but the variations in the weather during this period were so slight that the other influences which determine the general condition of the individual were most active in determining the amount of the average knee-jerk. The average movement gained from the 3,156 experiments of this series was 33 millimetres. Finally, all the sources of reënforcement which were noticed during the first series were found to be active during the second.

As a proof of these statements the author appends a table which gives a summary of the results gained in Series II, the table being made on the same plan

as the table on page 39, which gives the summary of the results of Series I.

SUMMARY OF RESULTS OF EXAMINATIONS OF SERIES II.

May, 1887.	7–8	9–10	11–12	1–2	2–3	4–5	6–7	8–9	10–11	Average K.-J. in mm.	Total No. of Examinations.	Total No. of Experiments.	Mean Barometer.	Mean Thermometer.
9th..........	36	43	64*	52	54	39	49	31	41	45	9	225	30.012	65°
10th.........	47	60	50	41	41	55	28	39	29	43	9	227	30.190	65°
11th.........	39	53	24	31	26	28	26	24	28	31	9	239	30.009	70°
12th..... ...	23	44	31	31	36	20	23	30	25	29	9	218	30.002	71°
13th.........	37	51	27	14	25	38	23	29	14	28	9	246	30.005	66°
14th.........	39	54	30	24	16	37	25	27	35	32	9	228	30.310	60°
15th (Sun)...	38*	43	48	43	40*	...	18	29	37	37	8	211	30.230	66°
16th.........	26	46	54	24	35	37	25	35	32	35	9	229	30.080	66°
17th.........	29	46	43	31	46	19	30	38	24	34	9	225	29.910	68°
18th.........	36	37	24	33	36	33	45	39	37	35	9	227	29.850	69°
19th.........	33	52	33	35	25	25	26	29	37	33	9	228	30.020	72°
20th.........	38	33	36	25	25	33	33	25	21	30	9	228	30.020	72°
21st.........	36	38	37	26	23	8	14	26	7	24	9	224	30.170	72°
22d (Sun)...	26*	36	20	19	29*	...	9	22	16	22	8	201	30.160	70°
	34	45	37	31	33	31	27	30	27	33	124	3156	30.069	68°

*The examination was one hour late.

DERMAL SENSITIVENESS TO GRADUAL PRESSURE CHANGES.

BY G. STANLEY HALL AND YUZERO MOTORA.

Τῇδε δοκῶ ζητοῦσι φανεῖσθαι . ἀνάτη πότερον ἐν πολὺ διαφέρουσι γίγνεται μᾶλλον ἢ ὀλίγον ;

'Εν τοῖς ὀλίγον.

'Αλλά γε δὴ κατὰ σμικρόν μεταβαίνων μᾶλλον λήσεις ἐλθὼν ἐπὶ ἐναντίον ἢ κατὰ μέγα.

Πῶς δ' οὔ ;

PHAEDRUS.
Stallbaum, ed. IV, p. 160.

Fontana observed that when a very slight pressure was applied directly to an excised motor nerve it might be made to increase so gradually as to crush the nerve without causing its muscle to contract. Afanasieff and Rosenthal found also that temperature might be increased and decreased so gradually as to kill a motor nerve trunk without stimulating it. Ritter and others since have found that the electric current has no effect if the density of the current is made to vary slowly enough. Heinzman[1] undertook a more serious experimental solution of the question whether a thermal stimulus could increase so gradually as to be unobserved by the sensory nerves so that death would finally supervene without any movement of either resistance or escape on the part of the animal. Frogs were heated (*a*) locally with a leg in water gradually warmed, and (*b*) totally by sitting on a cork floating in a cylinder of water, though it was much harder to boil intact and normal than brained or reflex frogs without sensation enough to cause motion. Their sensory seemed to

[1] Weber die Wirkung sehr allmäliger Aenderungen thermischer Reitze auf die Empfindungesnerven. Archiv für die gesammte Physiologie. Bd. VI (1872) S. 222.

conform to motor nerves in this respect. Fratscher[1] repeated these experiments, heating very gradually, by means of a lamp applied to the small bulbous end of a tube communicating with the large vase of water in which the animals were exposed, and found he could even induce rigor mortis in normal frogs by immersing only a small portion of the body in the fluid. Acid and alkali stimuli he found might also be applied so gradually as to kill the tissues without stimulating movement. The researches of W. T. Sedgwick,[2] to whose discussion of the topic the reader is referred, seem to show conclusively that in the case of heat this cannot be due to a diminished irritability of the spinal cord by reason of the heat carried into it by the blood, and that organs with a basis of protoplasm cannot so far reverse its laws as to completely lose functional power with no preliminary phase of increased activity.

Quite apart, however, from the question of painless death in such cases the problem of the gradual differentiation of sensation, though so little explored, abounds in practical and theoretical implications of great interest, and a series of determinations was begun here in 1884 upon the pressure-sense according to the following method: A balance, devised and made expressly for this purpose, consisted of a solid iron base and a strong brass beam seventy-two centimetres long, hung on a steel edge and sensitive enough to be far beyond the limit of differential perception with the initial weights used. Along the whole length of the beam runs an edged iron plate,

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[1]Weber continuirliche und langsame Nervenreizung; Jenaische Zeitschrift. N. F. I. 1. (1875) S. 130.

[2]On the variation of reflex excitability in the frog induced by changes of temperature. Studies from the Biological Laboratory of the Johns Hopkins University, 1882. Page 385.

made very true, to serve as the track for a truck, from which was suspended a little platform to carry weights. To this was attached a long horizontal band running about the drum of a kymograph, which we used as a motor on account of its approximately uniform rate of motion, changes in the latter being found, by careful measurement, so small within the times we used that they could be disregarded. The contact of the knife edge, on which the balance was pivoted, with its support, the center of the pivots of the wheels on the truck, and the application of the force by means of the band, were all on the same level, and by this means the effects of traction on the free oscillation of the balance were so slight that sudden reversals of the direction of motion, which could be brought about instantly at any time by a key described in a previous communication [Mind, No. XL., page 557], did not sensibly affect it. The car, which, after careful experiments with flowing sand (which suggests how irregular the best hour-glasses must have been), was found to be much more reliable, may thus travel along the entire length of the beam, and bearing any weight placed on its platform, at any rate in which the drum can be set in motion, and a pointer which it carries may be made to pass over the divisions of the millimetre-scale on the track to the beat of a metronome. Certain suitable velocities and weights with the rate of increment of pressure per second were carefully predetermined. Under one end of the beam was a metalic button, any size of which could be used, which was covered with rubber to eliminate temperature sensations—a matter which, where the contact of such an arrangement is for so long times, must be con-

stantly regarded—by which the pressure was applied to the skin, and on the other end of the beam was a small table with fixed positions for counter-weights, by which, together with the position of the car, which could be started at its full velocity at once, the amount of initial pressure was determined. To minimize oscillations the counterweight was removed by means of a cam.

The mode of making observations upon the volar tip of the index finger, *e. g.*, is as follows: The arm is rested on a comfortable support, the hand turned upward and the eyes closed. A special receptacle is made to fit the whole surface of the nail into which it is laid just under the button, which is brought down to within a millimetre of it by a screw supporting the other overweighted end of the beam. At a signal the counterweight is lifted by the cam, and after a fixed interval of from one to four seconds, during which all oscillations, if there be any, has ceased, by a turn of the key the car begins to move without noise or jar, and the differentiation begins, while the time, involving the amount of increase or decrease of weight, is recorded by a metronome till the percipient decides whether the weight is increasing or decreasing and signals to stop the apparatus, and says plus or minus accordingly. The wrong judgments by all observers throughout were found to be so very rare that they have been disregarded. The protocol thus gives us the point of application (commonly the tip of the left forefinger), the initial weight, the absolute amount of pressure increase or decrease per second, and the time required for a judgment. As the experimentations progressed the two chief causes of variation, viz.: changing degrees of attentives and of certainty, steadily diminished.

TABLE I.

	5	10	20	30	40	50	60	65	70	75	80	85	100	200	500
		16.05	13.08	14.26	10.16	7.36				4.02	3.14	5.4	5.26	6.1	
H. B. N........		+14.06	+11.91	+12.25	+8.17	+7.23				+3.54	+3.17	+5.3	+4.28	+5.4	
		−18.10	−14.23	−16.12	−12.	−7.5				−4.5	−3.11	−5.5	−6.23	−6.9	
	17.4	13.37	12.3	10.8	7.5	8.2				6.65			6.15	7.25	
H. N...........	+18.4	+13.1	+11.5	+ 9.9	+6.5	+7.9				+5.7			+5.1	+6.1	
	−16.4	−13.65	−13.1	−11.9	−8.5	+8.5				−7.6			−7.2	−8.4	
	16.7	7.42	6.02	5.22	5.82	7.88				8.3			5.67	7.7	
E. H. B.........	+15.8	+7.	+5.7	+4.7	+4.9	+6.8				+8.			+5.54	7.5	
	−17.6	−7.8	−6.2	−5.7	−6.8	−8.7				−8.6			−5.8	−7.9	
	15.95	9.05	11.05	7.5	10.05	11.4	10.45						12.45	10.75	
J. M............	+15.40	+8.4	+9.8	+7.8	+8.7	+8.2	+8.						+10.3	+8.	
	−16.30	−9.7	−12.3	−7.2	−11.4	−14.6	−12.9						−14.6	−13.5	
	22.1	16.1	12.12	8.23	10.41	8.11	7.3	6.96	6.88	7.28			8.77	8.4	10.21
Y. M..........	+23.9	+16.4	+13.26	+9.05	+11.7	+9.12	+6.7	+7.3	+6.6	+7.2			+8.4	+6.9	+7.31
	−20.3	−15.8	−11.04	−7.4	−9.12	−7.1.	−7.8	−6.7	−7.4	−7.3			−9.15	−9.9	−13.12
	6.85	8.05	8.25	8.75	9.5	8.35				12.35			14.05	+13.	
C. H.....	+7.50	+8.1	+7.5	+8.7	+9.	+7.5				+10.10			+13.3	+11.8	
	−6.2	−8.	−9.	−8.8	−10.	−9.2				−14.60			−14.8	−14.2	

In the preceding table the upper horizontal line expresses the initial weight in grammes. The rate of differentiation per second is always $\frac{4}{125}$ of this. The numbers are seconds and fractions of seconds. Of the signs prefixed plus denotes increase of weight and minus decrease, the numbers above with no sign being the average of the two below. Each number is an average, of twenty single experiments. Thus, with an initial weight of five grammes, where the rate of differentiation would be 0.16 grammes per second, it takes Y. M. 22.10 seconds to make up his mind with confidence whether the change of pressure he knows from the signal is taking place, is an increase or a decrease, while J. M. decides in 15.45 seconds.

TABLE II.

	$\frac{16}{125}$	$\frac{8}{125}$	$\frac{4}{125}$	$\frac{2}{125}$	$\frac{1}{125}$	$\frac{1}{250}$	$\frac{1}{500}$
H.B.N.		3.28 +3.25 —3.31	7.36 +7.23 —7.50	9.36 +9.23 —9.50	15.29 +14.67 —16.00	20.36 +19.00 —21.83	
H. N.	3.70 +3.80 —3.60	5.55 +5.40 —5.70	8.20 +7.90 —8.50	8.15 +7.65 —8.65	12.50 +11.90 —13.10	21.50 +21.33 —21.71	
E.H.B.	3.05 +3.10 —3.00	5.40 +5.40 —5.30	7.88 +6.80 —8.70	8.48 +7.66 —9.23	9.96 +9.25 —10.60	14.68 +14.91 —14.46	
J. M.		6.45 +4.1 —8.6	11.4 +8.6 —14.6	9.9 +10.2 —9.6	11.7 +11.2 —12.2	21.2 +20.5 —21.9	80. +85. —75.
Y. M.	3.43 +3.44 —3.42	4.58 +4.93 —4.36	8.10 +9.12 —7.10	11.65 +9.88 —12.98	22.76 +21.00 —24.40	34.04 +31.60 —37.80	66.00 +67.00 —65.00
C. H.	4.40 +4.80 —4.00	4.85 +5.10 —4.60	5.25 +5.10 —5.40	5.85 +6.10 —5.60	7.40 +7.10 —7.70	7.60 +8.00 —7.20	

In Table II the initial or threshold weight is constantly 50 grammes, which from Table I seems about the most favorable for all individuals for further exploring the psycho-physic relation here, and the rate of differentiation varies from $\frac{16}{125}$ to $\frac{1}{500}$ of this threshold value per second, the numbers as before representing seconds and each expressing an average of twenty single records.

TABLE III.

	5	10	20	30	40	50	60	65	70	75	80	85	100	200	500
		5.14	8.37	13.69	13.	11.77				9.6	8.04	14.69	16.83	39.04	
H. B. N........		+4.5	+7.62	+11.76	+10.46	+11.57				+8.5	+8.12	+14.42	+13.69	+34.56	
		−5.8	−9.1	−15.47	−15.36	−12.				−10.8	−7.96	−14.96	−19.93	−44.16	
	2.78	4.28	7.87	10.37	9.6	13.12				15.96			19.68	46.4	
H. N...........	+2.96	+4.19	+7.36	+9.05	+8.32	+12.64				+13.68			+16.32	+39.04	
	−2.64	−4.37	−8.38	−11.42	−10.88	−13.6				−18.24			−23.04	−53.76	
	2.67	2.37	3.85	5.01	7.45	12.6				20.04			18.11	49.28	
E. H. B........	+2.63	+2.49	+3.65	+4.51	+6.27	+10.88				+19.2			+17.73	+48.	
	−2.83	−2.24	−3.97	−5.47	−8.70	−13.92				−20.64			−18.56	−50.56	
	2.55	2.89	7.07	7.02	12.86	18.24	20.06						39.84	72.	
J. M.......	+2.61	+2.69	+6.27	+7.49	+11.13	+13.12	+15.36						+32.96	+51.2	
	−2.46	−3.10	−7.87	−6.91	−14.6	−23.36	−24.77						−46.72	−86.4	
	3.5	5.15	7.75	7.9	13.32	12.97	14.02	14.48	15.41	17.49			27.87	54.4	163.36
Y. M...........	+3.8	+5.24	+8.48	+8.69	+14.98	+14.59	+12.86	+15.18	+14.78	17.28			+26.88	+42.88	+116.96
	−3.2	−5.05	−7.06	−7.1	−11.77	−11.37	−14.98	−13.94	−16.57	17.52			−29.28	−63.36	−209.92
	1.09	2.58	5.28	8.4	12.16	13.36				29.64			44.96	83.2	
C .H.........	+1.20	+2.59	+4.8	+8.35	+11.52	+12.				+24.24			+42.56	+75.52	
	— .99	−2.56	−5.76	−8.45	−12.8	−14.72				−35.04			−47.32	−90.88	

In Table III. the upper horizontal line represents initial weights in a series of observations, the differentiations being always $\frac{4}{125}$ of the threshold per second. The figures of the table represent the grammes and fractions of a gramme it was found necessary to add or subtract before the difference was perceived. This was calculated from the first table.

TABLE IV.

	5	10	20	30	40	50	60	65	70	75	80	85	100	200	500
H. B. N.		1.51	1.42	1.45	1.32	1.23				1.13	1.1	1.77	1.17	1.19	
		+1.45	+1.38	+1.39	+1.26	+1.23				+1.11	+1.1	+1.77	+1.14	+1.17	
		−1,58	−1.45	−1.51	−1.38	−1.24				−1.14	−1.09	−1.78	−1.2	−1.22	
H. N.	1.56	1.43	1.39	1.34	1.24	1.26				1.21			1.19	1.23	
	+1.59	+1.42	+1.36	+1.31	+1.2	+1.25				+1.18			+1.16	+1.19	
	−1.53	−1.44	−1.41	−1.38	−1.27	−1.27				−1.24			−1.23	−1.28	
E. H. B.	1.53	1.24	1.19	1.17	1.19	1.25				1.27			1.18	1.25	
	+1.52	+1.25	+1.18	+1.15	+1.15	+1.22				+1.25			+1.18	+1.24	
	−1.56	−1.22	−1.20	−1.18	−1.22	−1.28				−1.28			−1.18	−1.25	
J. M.	1.51	1.29	1.35	1.24	1.32	1.36	1.33						1.4	1.36	
	+1.52	+1.27	+1.31	+1.25	+1.28	+1.26	+1.25						+1.33	+1.25	
	−1.49	−1.31	−1.39	−1.23	−1.36	−1.46	−1.14						−1.47	−1.43	
Y. M.	1.7	1.51	1.37	1.26	1.33	1.25	1.23	1.22	1.22	1.23			1.28	1.27	1.31
	+1.76	+1.52	+1.42	+1.29	+1.37	+1.29	+1.41	+1.23	+1.21	+1.23			+1.27	+1.21	+1.23
	−1.64	−1.50	−1.35	−1.23	−1.29	−1.22	−1.25	−1.21	−1.23	−1.23			−1.29	−1.31	−1.42
C. H.	1.22	1.26	1.26	1.28	1.3	1.27				1.39			1.45	1.41	
	+1.25	+1.26	+1.24	+1.28	+1.29	+1.24				+1.32			+1.43	+1.37	
	−1.20	−1.26	−1.28	−1.28	−1.32	−1.29				−1.46			−1.47	−1.45	

The fourth table represents the ratio between the threshold and the numbers expressed in the third table. In that table it was necessary for an initial weight of 5 grammes to be differentiated to the amount of two and seventy-eight hundredths grammes in order that the difference should be perceived by H. N., and five is to this number as twenty to fifty-six hundredths, as is shown in Table IV.

TABLE V.

	$\frac{16}{125}$	$\frac{8}{125}$	$\frac{4}{125}$	$\frac{2}{125}$	$\frac{1}{125}$	$\frac{1}{250}$	$\frac{1}{500}$
H.B.N.		10.49 +10.4 —10.59	11.77 +11.57 —12.	7.49 +7.38 —7.6	6.12 +5.86 —6.40	4.07 +3.8 —4.36	
H. N.	23.64 +24.32 —23.04	17.76 +17.28 —18.24	13.12 +12.64 —13.6	6.52 +6.12 —6.92	5. +4.76 —5.24	4.3 +4.26 —4.34	
E.H.B.	19.52 19.85 19.20	17.28 +17.60 —16.96	12.6 +10.88 —13.92	6.78 +6.13 —6.38	3.98 +3.7 —4.24	2.94 +2.98 —2.89	
J. M.		20.45 +13.12 —29.46	18.24 +13.12 —23.36	7.92 +8.16 —7.68	4.68 +4.48 —4.88	4.24 +4.1 —4.38	8. +8.5 —7.5
Y. M.	21.95 +22.02 —21.88	14.59 +15.78 —13.95	12.96 +14.5 —11.37	9.32 +7.9 —10.38	9.14 +8.4 —9.76	6.8 +6.32 —7.56	6.6 +6.7 —6.5
C. H.	28.16 +30.72 —25.60	15.52 +16.32 —14.72	8.41 +8.16 —8.64	4.68 +4.88 —4.48	2.96 +2.84 —3.08	1.52 +1.6 —1.44	

TABLE VI.

	$\frac{16}{125}$	$\frac{8}{125}$	$\frac{4}{125}$	$\frac{2}{125}$	$\frac{1}{125}$	$\frac{1}{250}$	$\frac{1}{500}$
H.B.N.		1.21 +1.22 —1.23	1.23 +1.23 —1.24	1.15 +1.15 —1.15	1.12 +1.11 —1.13	1.08 +1.08 —1.09	
H. N.	1.47 +1.49 —1.46	1.35 +1.34 —1.36	1.26 +1.25 —1.27	1.13 +1.12 —1.14	1.1 +1.1 —1.1	1.09 +1.08 —1.09	
E.H.B.	1.39 +1.40 —1.38	1.34 +1.34 —1.34	1.25 +1.22 —1.28	1.13 +1.12 —1.14	1.08 +1.07 —1.08	1.06 +1.06 —1.06	
J. M.		1.4 +1.26 —1.43	1.36 +1.26 —1.46	1.16 +1.18 —1.15	1.09 +1.07 —1.10	1.08 +1.08 —1.09	1.16 +1.17 —1.15
Y. M.	1.44 +1.44 —1.44	1.29 +1.31 —1.28	1.27 +1.31 —1.24	1.18 +1.16 —1.20	1.18 +1.17 —1.19	1.13 +1.12 —1.15	1.13 +1.13 —1.13
C. H.	1.56 +1.61 —1.51	1.31 +1.33 —1.29	1.17 +1.16 —1.17	1.09 +1.1 —1.09	1.06 +1.06 —1.06	1.03 +1.03 —1.03	

The fifth table represents the same relations as the third, except that the calculation is based on the experiments of the second table, while the third table is based on the first. The sixth table represents the same relations as the fourth, except that it is based on the fifth as the fourth is based on the third.

These results are presented so clearly in tables IV and VI that graphic representation in terms of ordnates and abscissas is unnecessary. They are more nearly uniform with Y. M., H. N. and H. B. N., while the other three deviate more from these and from each other. A relation very inaccurately approaching the constancy expressed by Weber's law is obvious, but is not only inexact, but appears only within limits themselves also subject to wide individual variations. C. H. (of Tables I and IV *e. g.*) recognizes a

differentiation of a constant rate per second with from as little as five up to from fifty to seventy-five grammes as an initial weight, while H. B. N. does not reach any constancy with an initial weight less than that of the upper limit of C. H. The latter subject (C. H.) was however especially selected from a furniture factory as a polisher and sand-paperer of exquisite pressure sense. This wide range of individual variation, which may be caused by both culture and heredity, may be utilized by anthropological methods, but from the results of experiments in the field of the psycho-physic law most analgous to ours was perhaps hardly to have been expected, at least with students with fingers uncalloused by manual labor.

Compared with the sensibility to differences of pressure determined by the more faultess of the many experiments with the appreciation of weights successively applied, our results show on the whole less sensitiveness. In some cases a change of $\frac{1}{20}$ or $\frac{1}{30}$ or even less of the initial weight has been perceived while with us, under the most favorable conditions (which seem *e. g.* in Tables II and V to be when a variation of $\frac{1}{0}$ of the initial weight of 50 grammes occurred per second) the judgment responds to a variation of about $\frac{1}{12}$.

In the study of capillary blood pressure in the human skin made by v. Kries,[1] a plate of glass was applied to the dermal surface and its pressure regulated by weights suspended to it below, and the effect, measured by the amount of paling, observed. The different thickness, rigidity and vascularity of the skin, as well as the method of observation, made results by

[1]Uber den Druck in den Blutcapillaren der menschlichen Haut. Ludwig's Arbeiten, 1875.

this method very inexact. Yet the great effect upon capillary pressure produced by raising or depressing the arm, though much less than would be caused by the different positions of the limb, according to hydrostatic laws, was so considerable as to suggest a precaution against possible errors which we observed by keeping the hand at the same relative altitude with reference to the rest of the body. Again, Fechner admits that the pressure sense is liable to errors in that the elasticity of the skin prevents the pressure upon the nerve in terminal organs from corresponding exactly with the weight laid on the skin. The depression of the skin touched by the button was measured by means of a cyclometer by Y. M. for various weights upon his own fingers as follows—

WEIGHT.	DEPRESSION.
5 Grammes.	.2151 Millimetres.
10 "	.4992 "
20 "	1.0078 "
30 "	1.3310 "
40 "	1.6784 "
50 "	1.7187 "
100 "	2.7490 "
200 "	3.0616 "

With our apparatus the smallest initial weights used bring the button in contact with the skin over its entire surface, and pressure does not increase the surface of contact as would be the case with a larger button. Increasing weight depresses new skin from a wider and wider area around the surface of contact, and may change the distribution of pressure over this surface, especially as between its centre

and edges. Time is also probably a factor of the amount of depression and expulsion of blood. With the largest weights and longest times used by us, however, there is no distinct indication of insensitiveness increasing with the gradualness of the increment that seems due to local anæmia by pressure. If sensitive human tissue can be crushed without pain by increasing the pressure gradually enough after the analogy of Heinzmann's and Fratscher's experiments with heat applied to normal frogs, or even unusually great pressure-differentiation can be made so gradual as to escape attention when especially directed to it, a different apparatus method of experimentation than that used in this series of observations is needed.

How, then, shall we explain the new relation that appears between the last two columns of Table II.? Here, when the rate of differentiation of a constant initial weight is $\frac{1}{500}$ per second the time is nearly double what it is for a rate of differentiation of $\frac{1}{250}$ per second for Y. M. and nearly quadrupled for J. M. If the law of constant increment held irrespective of time, the numbers in each column should be double those corresponding to them in the column before, which occurs in but one case and approximately only in a very few other sporadic cases. Indeed, even the results of the last column may possibly be sporadic. We should expect however a priori a point somewhere where an increase in the time of applying a differentiation would diminish sensitiveness for it, but that this is reached in the last two columns of Table II., the results are too few to make us certain. Another problem presented by Table II. is to account for the great obtuseness for

differentiations applied at a relatively rapid rate. J. M., *e. g.*, is nearly four times as sensitive to differentiation applied at the rate of $\frac{1}{250}$, of the original weight, as he is when it is applied at the rate of $\frac{8}{125}$ of it per second.

In the best psycho-physic experiments involving the comparison of two weights, they are applied successively, with a definite time for contact, interval of rest, etc.—the application of both weights occupying *e. g.* five seconds—and the attention is then directed to the task of comparing the impression superposed in memory. In pressure, as opposed to lifting tests, little attention has been paid to the speed of application and levitation of the weights. With the second weight we might conceive that cells excited by the first are reëxcited, a few being left out of function, or a few new ones excited, according as the heavier weight comes first or last. By this method of gradual differentiation, however, the acts of comparison and judgment must go on during the process of the change, and the more rapid it is the greater the distraction. The comparison is made between an initial pressure held in memory and a present changing sensation. If memory were merely a faint sensation rapidly loosing intensity, we should have a double differentiation. The remembered initial pressure would fade like an after-image, while the present pressure is constantly increasing, and the differential sensibility would be finer than in the old method. The fact that it is less so cannot be entirely explained by the time required to stop the apparatus after a judgment is made, for that reduces itself in our experiment nearly to the reaction time from ear to hand of the person con-

trolling the drum, for the subject under observation gave the signal to stop the apparatus as soon as he felt a judgment within his reach, as it were, and it was expressed and recorded later. It is obvious, however, that a part, perhaps considerable, of the apparent decrease of sensibility from rapid differentiation is due to this constant error, but not all. Besides the perception-time a longer time is required to relate the two impressions in consciousness. The mind, our subjects think, does not keep or have at any time an image or feeling of continuous increment or decrement, ' Continuity here seems an impossible perception. The attention rather singles out an instant or degree of pressure and compares it with another instant and degree of pressure still further past (and, in fact, not invariably the period of the initial weight), and an impression arises or does not arise, which it is perhaps quite as correct to speak of as a sensation of difference, with a tolerably clear threshold of its own, as a judgment. Indeed, it seems to be impossible to excite a sensation of continuous increment. Again, with certain initial weights and certain rather rapid rates of differentiation, it is hard not to believe that the sensation changes in quality as it changes in quantity, and it may be impossible, with different tactile organs or fibre-ends at different depths of the skin, to get a quantitive change of entire purity. It is hard, however, to resist the impression that, quite apart from these minimal and inconstant changes of quality, the attention finds it difficult if not impossible to grasp continuity in the form of quantitative or intensive change, but rather that the directness of a graduated series is the basis immediately given, and that continuity is derivative and inferred.

Constancy, or uniformity, (as distinct from continuity), of sensory increment is of course not to be expected here, for it is the stimulus that increases uniformly per second, and the sensation, according to the law of Weber, must increase more slowly. Each second of increase bears a constantly less ratio to the total pressure of the preceding second, and if the pressure is decreasing, is in a larger ratio to it. Thus, as the differentiation goes on, a longer and longer time is necessary to create a given ratio for increasing and a less and less time for decreasing pressures. This fact probably is the chief cause of the rather large average errors for increasing weight. The later seconds effect even less sensory modifications than the first. Both greater sensitiveness and less average error in time might therefore be expected from decreasing pressures. The figures show, however, on the contrary, less sensitiveness and no greater uniformity. The most obvious cause for this result is fatigue. The cells, relieved from the effects of pressure, have been excited longest, while the mind has less interest in vanishing than in augmenting impression, and it is harder to bring the attention to bear on them.

In an interesting study by F. C. Müller,[1] which was begun on the excised nerve-muscle preparations of frogs, but extended to motor and then to sensory human nerves percutaneously excited and pointing to a "neurophysic," in place of the psycho-physic law, the author conceives changed excitability as an essential property of sensation. In the experiments of Wedenskii, and especially of Bowditch[2], whose

[1]Physiologische Studien ueber Phychophysik. Archiv f. Anat & Physiol, 1886. Heft. IV.

[2]Science Aug. 27, 1886.

tests seem as conclusive as they are important, changes due to fatigue cannot be assumed for the nerve fibre, but must be limited to terminal organs, the blood supply of which, as we have seen, is reduced by pressure, and to central cells." Our experiments allow no interval for rest and increased sensitiveness between the two degrees of pressure, which give rise to the impression of difference such as intervenes in the application of two successive weights. Where the transition is directly from one degree of stimulus to another, with no temporal interruption, the process cannot be the same as when a period of rest intervenes, or even, as in Müller's experiments, where on the basis of the stimulus of a constant current another stimulus in the form of negative variation is applied. Another complexity, also tending to make decision hard and slow, is that there are really three degrees of pressure to be constantly borne in mind—the original pressure as well as the alternative of increase or decrease—while in the most approved application of Fechner's three methods the problem has but two terms. The method of middle gradation only admits of comparison even in this respect with ours. Thus, in fine, whether we look at the number of terms involved in each verdict of consciousness, fatigue, the nature of the mental activity involved, the results, or every detail of method, we have here a new standpoint for viewing psycho-physic relations, and few if any safe inferences from one to the other between the work of Weber and Fechner and their successors and ours can be trusted. We are here confronted with new problems of great range and importance, which the above preliminary results, very far from solving,

barely suggest. What is the ratio, *e. g.*, between increasing suddenness and decreasing weight in producing a given sensory effect? On the one hand the mind has a horror of what is sudden which may amount almost or quite to kataplexy, which knowledge of law and power of prediction serve to alleviate; and, on the other, great changes, if very gradual, are not only imperceptible, but can only be ascertained by indirect and often very circuitous inference. If we compare the conscious minds of men to balances, some tipping to a greater and some to a less weight, we can only reply to the question why they do not tip to still finer stimuli, like the millionth leaf in Leibnitz's forest, by saying that, on the one hand, a practical threshold relieves it from distractions and irrelevancies and favors concentration by abstraction, or else that nature, as it were, suspects consciousness, and that its too great acuteness has been a disadvantage, and that attention must not be too discriminative nor admitted to all spheres of life. It is at least impossible to see any more contradiction between the law of probabilities and what Fechner would call the threshold theory of life, than between the untonality of octaves played by the wind on an Æolian harp and the same octaves on a piano with a pure untempered scale. Consciousness, in some of its aspects, has an articulating habit of dropping the fingers down upon the strings instead of sliding them along.

The following table gives the result of a series of records with heavy initial pressure and slow rates of differentiation, these being the conditions most favorable to fine discrimination:

TABLE VIII.

	1000.			500.			250.			125.		
	+	0	—	+	0	—	+	0	—	+	0	—
Y. M.	100.	128.	128.	66.	76.	78.	20.	20.	21.	18.	21.	18.
M. G.	88.	92.	104.	38.	—	56.	23.	28.	26.	11.	13.	12.
J. T.	60.	96.	94.	26.	72.	44.	23.	29.	28.	10.	11.	11.
Average...	82.	105.	104.	43.	59.	60.	22.	25.	25.	13.	18.	13.

All the figures in this table are grammes. Those above are the four initial weights, and the rest are grammes of increase rest or decrease before the judgment was made, the rate of differentiation throughout being 0.4 per cent. of the initial weight per second, each figure expressing the average of fifteen single observations, and the grammes under each of the four middle zero columns expressing the differentiation that would have taken place if differentiation there had been. Here again there is a general approximation to a constant ratio. The differential sensibility is finer than with smaller initial weights. With all these weights, and especially the lightest, it takes much longer to perceive rest or a minus quantity. This is expressed less, however, in the table above than in the following table of errors—

TABLE IX.

	0 = +	— = 0
1000.......	4.	42.
500.......	40.	38.
250.......	24.	21.
125.......	9.	10.

The figures in the above table express the per cent. of mistaken judgments, (calculated for not far

from fifty single judgments each.) Rest, *e. g.*, is judged to be increase in forty-five per cent. of the cases with an initial weight of 1,000 grammes, and decrease is judged to be rest in forty-two per cent. of cases with its same initial weight. These may be called errors of overestimation, and all errors of underestimation are comparatively rare, as are errors of overestimation when decrease is judged to be increase. That we should be insensitive to decrease was expected from fatigue and expulsion of blood caused by so heavy weight. That rest should so often seem to be increase may be due to gathering energy of attention or perhaps to the progressive action of heavy pressures upon the circulation in the tissues beneath. The fact that we tend to judge even rest as increase seems here, at least, to have made the result indicate greater sensitiveness to increase than if it had been practicable to start the differentiation, to be judged on the basis of the presumptive, slight, constant decrease required to offset this tendency, and which would therefore seem to consciousness to be rest. This constant we designate as the *apparent pressure constant*, and its variation at a given second during the process of an observation we call the *pressure deviation* of that decrease.

In another series of observations the effect of negative pressures or pulls upon the skin of the ball of the left index finger were studied as follows: After a number of trials with various salves and plasters in the market, one was at length found that was sufficiently adhesive, and within the limits of fifty grammes would not crack or give in a way to afford an independent clue to sensation as most do.

The finger nail was then glued to its socket in a heavy block below, and the beam of the balance allowed to swing freely, till, controlled by the position of the car, it came to rest in such a place as exactly to touch, without pressing, the upturned ball of the finger to which it was then also firmly stuck. The car was moved so as to give a very slight but distinct pressure, and then made to travel slowly away from the finger by means of the drum till a sensation of negative pressure, or a pull upward, was detected. It then traveled back till a positive pressure could be felt. Each of these pressures was repeated ten times and then averaged, and then the average of these plus and minus averages taken. This latter might be expected to give the original position of equilibrium of the car empirically determined as above (provided, of course, that the skin is equally sensitive to a push or a pull). The apparent was found, however, to be slightly more negative than the empirical indifference point, determined as above, in each of four subjects. As the pressure gradually changes from a minus to a plus quantity, or conversely, the neutral position is tolerably well marked to consciousness. The sense of contact is present, but without appreciable pressure or pull, as the finger is not absolutely flat even over the small surface of four or five milimetres in diameter, and as tactile experience is rarely with surfaces curved exactly conformably with the shape of the epidermis at rest, as it so nearly is in this case. A sensation of touch over such a surface, which in common tactile experience is impossible without pressure, might be expected to suggest pressure here. Possibly it will be found that it is in-

stinctive compensation for this association that makes a discrepancy between the *real and apparent tactile zero,* as we shall hereafter designate the mechanical and the sensory indifference points, respectively. Even should our further studies find them to coincide, it will be useful to retain both designations.

The apparent tactile zero thus determined is the starting point of our differentiations. The car is drawn to the position corresponding to this position of least sensation, and the percipient, after five seconds rest, hears the signal announcing the start of the car, and is to judge as soon as he can whether the skin is pressed or pulled upward. The sensations for a time are surprisingly indistinguishable. For a moment the change seems decidedly plus, an instant later it appears as certainly minus. The experience is comparable to that of binacular rivalry, where now the picture or color presented to one eye, now that before the other seems to predominate and indeed suggests quantitative determinations in this latter field. For this phenomenon we suggest the name of *antinomous dermal rivalry.* How far, if at all, this may be connected with the fact that every pull depresses the adjacent skin on the sides of the finger (which parts of the skin pressure distends), further studies must make known. On an average finger, disposed as above, a pull of *e. g.*, 20 grammes elevates the skin about three-fourths as much as the same weight depressed it. By referring to the preceding table of cyclometer measurements for the latter, it will thus be seen that in these determinations the beam of our balance has a movement of several millimetres, and emperical deter-

minations showed us that a slight but constant allowance must be made in the weights of the following table for overcoming the variation of the beam of the balance to even these slight changes of position. Making these deductions, we have the following sample of a single day's observations:

TABLE X.

	6.9.		2.6.		0.2.	
	+	—	+	—	+	—
G. S. H.....	12.7	13.3	....	....	7.9	6.9
Y. M.......	16.1	14.4	14 2	12.1	7.3	5.
E. C. S.....	13.	14.3	11.	16.9	8.8	1.2
Average....	13.9	14.	12.6	14.5	8.	7.9

In this table the figures at the top express the amount of differentiation per second in grammes. The figures below are grammes before the judgments of positive or negative pressure, expressed by the signs plus and minus above, were made. Each figure in the table is an average of ten single observations. The numbers are slightly too large, for they represent almost continuous observations with an element of fatigue distributed about evenly, but not eliminated as in fuller tables reserved for the completion of our research on this part of the subject.

The first and chief result of this table is the relatively vast weights involved in differentiation. Aubert and Kammler found the smallest weights that could be perceived when applied to volar finger tip to be from 0.005. to 0.015. gms., and Goldscheider's touch-points are probably at least no less sensitive. Though he did not control the amount of pressure

which he used in determining his pressure points, he was led to distinguish between the sensation of contact and that of pressure,[1] and found even the latter exceedingly sensitive. The literature relating to the psycho-physic law contains almost no reliable tests of pressure between the first observable contact and weights of from six to ten grammes. Strictly speaking, moreover, the sensation of an upward pull upon the skin must not be compared with pressure from within outward along the arterial tracts, or as shown in plethismographic tracings, nor inflammations or throbing sometimes called pounding pains. Nor is the collapse of supportive tissue beneath, which has been suggested as a cause of abnormal dermal sensations, more relevant than the sensations of the elastic skin artists who pull out folds of their skin into dewlaps. In fact, whether negative pressure, although it must favor a different distribution of capillary circulation from a pressure on the same spot, excites any specific sensation other than that of contact (which it may serve to show is specifically different from pressure), and secondary depression by stretching of adjacent dermal tissue, it is idle to conjecture.

On the whole, then, it may be said that, save the older determination of the smallest observable pressure from different parts of the dermal surface, and which since the works of Goldscheider need to be carefully revised, we know at present almost nothing with certainty about pressures below five or ten grammes. As we approach minimal pressures we pass outside the limits of validity for the psycho-

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[1] Neue Thatsachen über die Hautsinnnerven; Arbeit für Physiologie, 1885. Supplement-Band, p. 88.

physic law which has prompted most of the modern work in this field. Yet precisely within this realm covered by antinomious dermal rivalry lie the mysterious conditions of the tickle-sense by contact as distinct from the specified and localized tickle-sense, of abnormal excitability passing spontaneously into excitation where we have not yet learned to distinguish subjective from objective sensations, and with respect to which the mind of the adult is still in a rudimentary infantile condition. We also observe here that within these limits the slower differentiations are more finely distinguished. A definite law with regard to the comparative sensibility to pressures and pulls is not yet apparent.

When one index finger is under the button of each end of the balance so that the weight decreases on one finger as it increases on the other, there is no essential increase of sensitiveness, and in some cases a decrease. It requires some time and effort to accommodate the attention alternatively from the finger of one hand to the corresponding finger of the other.

A METHOD FOR THE EXPERIMENTAL DETERMINATION OF THE HOROPTER.

BY CHRISTINE LADD-FRANKLIN.

If the diagram of Plate III. be held in a horizontal plane in front of the face, with the arrow directed towards the bridge of the nose, and at such a distance that the circle, if produced, would go, roughly speaking, through two points a little below the centres of the eyes, an optical illusion will present itself. If one looks at the intersection of the middle cross, there will still be seen a cross on the plane of the paper, but there will be seen in addition a third line, which, if the paper is at the right distance from the eyes, will seem to stand up in a nearly vertical position, half above the plane of the paper and half below it. When the position is right for the middle cross, it is also right for all the others, and if the eyes are converged steadily upon the middle stick, the other crosses will also present nearly vertical sticks, visible by the lateral portions of the retina. The phenomenon is also pretty well preserved if the point of fixation wanders from one to another of the circular row of sticks. If the paper is gradually moved farther away from the eyes, the illusory stick may be made to look exactly vertical, but the position is not then quite right for the lateral portions of the field.

There are two points to be explained in this illusion: the presence of the third line and its upright position. Take a single pair of crossed lines,

Fig 2.

as in Fig. 2, hold them in a horizontal plane, and at such a distance that with the right eye shut, 1, and with the left eye shut, 2, looks like the projection of a vertical line. Now, with both eyes open, fixate a point at some distance beyond them (by sticking in a pin at that point if necessary). The lines will be seen double, as two entirely separate crosses. Let the point of fixation approach nearer to the intersection of the cross, and the double images will be brought nearer together until they partly overlap, and the appearance of Fig. 3 will be produced, where the image seen by the left eye is drawn in dotted lines, and the image seen by the right eye in uninterrupted lines. As the fixation point is brought still nearer to the intersection of the cross, the left-eye image of line 1 and the right-eye image of line 2 (which

Fig 3.

are parallel if the card is held at the right distance) come still nearer together, until the intersection is fixed and they exactly coincide. At the moment that they coincide, they leave the plane of the paper and become a single line in space, its lower end directed more or less exactly towards the feet of the observer. (Its exact position depends upon the position of the apparent vertical meridians for the given fixation point, which is different for different individuals.) As R_2 and L_1 unite, R_1 and L_2 present the appearance of a cross with the vertical line pass-

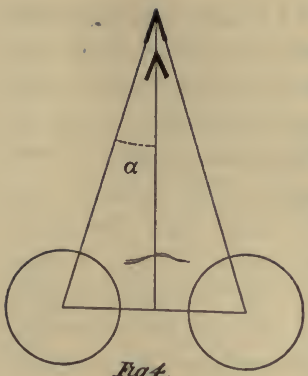

Fig 4.

ing through their intersection. If we apply the construction for the cyclopean eye,[1] what takes place will be represented by figures 4 and 5. Fig. 4 gives the position of the eyes and of two pairs of lines, cutting respectively in the fixation point and nearer than the fixation point. (For simplicity only the near half of each cross is drawn.) The picture seen by the right eye, shifted through the angle α gives the right hand half of Fig. 5, and in the same way the right eye's image furnishes the left hand half. The cyclopean eye, then, sees two parallel lines coincident when, and only when, the fixation point is at the intersection of a cross. It will be noticed that the angle seen between the lines of the cross is twice as great as the angle drawn.

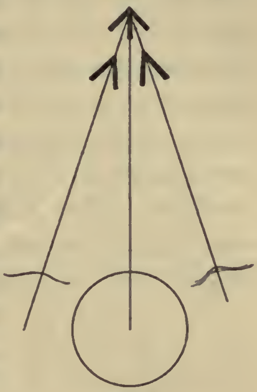

Fig 5.

This illusory line is seen as one, then, because images of two different lines fall upon corresponding rows of points in the two retinas. The reason that it seems to be nearly vertical is that the only line in the median plane which is capable of throwing its images upon corresponding rows of points is the

[1] Hering: Beiträge zur Physiologie, I., p. 43. 1861.

nearly vertical line. Look at a single line drawn in the median plane upon a sheet of paper, held near the eyes and horizontally before them. To the right eye alone its near end will seem shifted towards the left, to the left eye alone towards the right; it is only when the plane of the paper is directed towards a transversal line through the feet that the given line seems to either eye alone to be in the median plane. It is imposible that any single real line should throw its images upon the apparent vertical meridians unless it is in the intersection of the planes through those meridians respectively and the fixation-point. If images are artificially thrown upon those meridians by two different but exactly similar lines, the mind, which is entirely unaccustomed to having such tricks played upon it, cannot escape the conclusion that it is looking at a single line in that position. The illusion is a remarkably persistent one; no degree of clearness of understanding of its origin will enable one to avoid thinking that the middle stick is out of the plane of the paper, provided he has good double vision, and has the power of steadily fixing the intersection of the cross. But this two-eyed illusion is very little in need of explanation after it has been noticed that there is a corresponding one-eyed illusion. In Fig. 6, the lines are all drawn so as to pass through a common point.

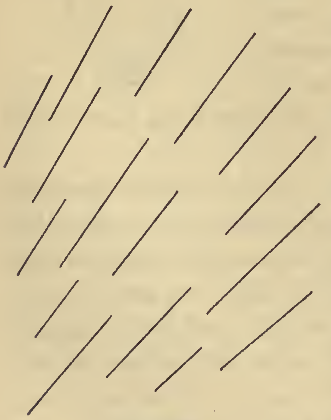

Fig. 6.

With a little trouble, one eye can be put in the position of this point,—it is only necessary that the paper be held so that, with one eye shut, the other eye sees all the lines leaning neither to the right nor to the left. After a moment, one can fancy the lines to be vertical staffs standing out of the plane of the paper. Fig. 7 is a modification of Zöllner's pattern, and, if looked at in the ordinary way, presents his well-known illusion. The short lines are not parallel, however, but each set passes through a point outside of the paper. If the paper be held horizontal, and if one eye be shut and the other put in the place of one of these points, the lines going through it will seem to be vertical, the other lines remaining horizontal. If the eye be now put in the place of the other point, the vertical and the horizontal lines will change places. I put a sheet of paper like this in position one day before the eye of a little girl eight years old, and asked her what she saw; she said a once, "I see two fences and two railway tracks."

Fig. 7.

This illusion I take to have a purely mental origin. When a line lies anywhere in a plane through the apparent vertical meridian of one eye, and is looked at with that eye only, then, if we do not know how long it is and if it does not present any characteristic reflections, we have no very good means of knowing

how it is directed in that plane,—the only means we have, in fact, is the amount of change of accommodation that takes place as we look from one end of it to the other. Now of the lines in nature which lie anywhere within such a plane, by far the greater number (trees, edges of buildings, flag-staffs, pendulums, &c.), are vertical lines; hence we are peculiarly inclined to think that a line which we perceive to be in such a plane is a vertical line. But to see a lot of lines at once, all ready to throw their images upon the apparent vertical meridian, is a thing that has hardly ever happened to us, except when they have all been vertical lines. Hence when that happens, we have a still stronger tendency to think that what we see before us *is* a group of vertical lines.

This illusion in regard to vertical lines is sometimes met with in nature. If one looks through a narrow tube at a small portion of china-matting, the straws of which run towards the feet, it cannot plainly be made out to be horizontal. There is a picture by Boughton in Mr. Walters' gallery in Baltimore, in which the paint which represents the surface of water is laid on with vertical strokes of the brush. If it be looked at with one eye, and with the hand held so as to cutoff the adjoining shore, it looks much more like a vertical wall than a level surface of water.

If, when looking at the one-eye lines, both eyes are suddenly opened, the sticks are instantly thrown down. In Fig. 7, however, the double images of the lines can be separated after a few minutes, and the appearance of vertical lines crossed by others is presented. But although the head be kept perfectly motionless, the vertical lines are tipped a little out of

their former position. The same effect is still more noticeable if two long parallel lines, at the exact distance apart of the eyes of the observer, are held horizontally before the eyes. To either eye alone, if the other be shut off by a screen, one or the other line looks perfectly vertical; but, with both eyes open, as soon as the vertical lines are distinguished, they are seen to have their nearer ends brought nearer together. This shifting may also be produced by forcible convergence of a shut eye, and an easy modification is thus furnished of a more difficult experiment of Le Conte's (*Sight*, page 186). It shows that though one eye looks at a near point, the outward rolling of convergence does not take place if the other eye is at rest.

In the two-eyed illusion of Plate III. all the lines are drawn so as to pass through one or the other of two points on the circle produced, and at a distance apart equal to the average distance between the two eyes. When the eyes take the place of these points, each eye sends to the brain information of a vertical line at the intersection of a cross, and their combined testimony is too strong to be in the least shaken by the knowledge that no such line exists.

If one has experience in uniting double images, the diagram may be held in various different positions, and a single line, variously situated in space, may still be recomposed. If it is held nearer to the eyes, the line declines into the plane, and if farther away, it becomes exactly vertical. If it is rotated in a horizontal plane, the line sinks down into coincidence with one branch of the cross, to rise again and fall into the other branch. If it is rotated into a vertical plane, the line points forward on top.

Looked at from underneath, the line is inverted; its top has now a slight indistinctness, which its bottom had before, for its top comes from the near portion of the cross, and accommodation becomes defective more rapidly coming in than going out.

When the line looks vertical it is not seen single throughout, although, if it is short, one is not easily aware of that fact. Support the plate on a table nearly on a level with the eyes, and fix the teeth in a head-holder[1] at such a distance as to make a line look vertical; its top may now be pricked in two by the point of a cambric needle; this cannot be done if the line is directed towards the feet. The divergence of its images is, in fact, the mark by which we know its degree of verticality. An actual vertical stick we see double at top and bottom, if we look at the middle of it, but our fingers have convinced us in so many millions of instances that the stick is not split, that we have come to quite overlook the visual splitting as splitting, but to give it its full significance as *sign of a vertical line.* It is really perceived, though not for itself, but only as part of a sensation-complex.[2]

This illusion derives its chief interest from the fact that it furnishes a very delicate means for determining whether we see double or not. When, in Fig. 2, the fixation point is near the actual intersection of the cross, the pair of parallel lines appear one on either side of the intersection of the imaginary cross, that is of the lines L_1 and R_2. When the fixation point is very near, the parallel lines are too

[1]Helmholtz, Physiol. Optik, p. 517.

[2]Stumpf: Ueber den psychol. Ursprung der Raumvorstellung, p. 270.

close together to be distinguished as separate lines, *but it can still be detected that the one which is seen is not at the intersection of the apparent cross,* and that is sufficient to show that the actual intersection is seen double. In the drawing of Plate I., the circle represents the theoretical horopter circle, which passes through the fixation point and the points in the eyes in which the sight lines intersect. The sight lines (*visirlinien*) are lines through points which appear to be in the same straight line—that is to say, the centres of whose diffusion circles coincide. They all cross in a point, which is in the image of the pupil formed by the cornea, and about 4 mm. in front of the mean nodal point.[1] The drawing must be supported on a horizontal table, and the head must be in a comfortable position and such that to one eye one set, and to the other eye the other set of lines lean neither to the right nor to the left. (If that cannot be done, it is because the drawing does not fit everybody's eyes). Some of the crosses do not cut on the circle. If one fixates one that does, and attends to the image in the lateral field of one that does not, then the latter can be made out to present the appearance above described. One sees now one and now the other of the vertical parallel lines, riding now on one and now on the other of the legs of the cross, and although one does not *see* the intersection double, one *infers* that he sees it double from the fact that he sees an apparent intersection with the line not going through it. So slight a separation of double images as this, one is quite unable to detect by any of the ordinary means. The effect

[1] Hering, Phys. Optik, p. 466.

can be obtained, for a certain distance around, by a person who has good control of his attention, but has had no experience at all in optical experiments; he can, at least, perceive that if he looks hard at the stick on the right of the middle one, for instance, the perfection of the illusion for the stick on the left is quite broken up. But the tangent to the circle at the first goes through the second; hence he has proved that the locus of points seen single is not the straight line tangent to the horopter circle at the fixation point. The imaginary sticks form sufficiently interesting objects of attention to enable one to fixate them without any trouble. They also serve to take the place of a head-holder. The drawing can be made at ease with a circle of any convenient radius, and with the distance between the fixed points calculated for the observer from his interocular distance and the given convergence. The head can then be got into the required position and held there simply by the appearance of the lines.

This diagram, then, is sufficient to prove, even to the inexperienced observer, that the horopter is a circle when the fixation point is median and nearly in the primary plane. The experiment may be varied by having movable crosses which can be shifted about on the plane of the paper, but in that case the angle should also be made capable of being changed, which can be done if it is made by threads wound about a bit of cardboard. To determine the points seen single very far around in the lateral field, something brighter would have to be substituted for black lines—flat strips of platinum made white hot by an electric current, for instance. I have not yet carried out this experiment. The lines suffice for a

point-to-point determination, of from twenty to thirty degrees at a time, and this would amount to exactly the same thing, if the horopter circle went through the centres of rotation of the eyes. As it is, a motion of the fixation point along the circle, as drawn, changes a little the position and the size of the horopter circle. There are, of course, difficulties in the way of carrying out the test for remote portions of the retina. Besides the difficulty of seeing anything distinctly, there come in differences of perspective, and hence of the apparent size of an object large enough to be seen at all; the error of accommodation, which is particularly great for vertical lines;[1] the inclination of the horizontal meridians for near convergence; and the difference in strength between the nasal and temporal halves of the retina, which Schön has shown to be a factor of critical importance in all phenomena of double vision.[2]

The best experimental determination of the horopter which has hitherto been made is that of Schön (l. c). He arranges two openings in screens with lights behind them in such a way that lines of direction cut on a point of the horopter circle, and the image of an opening is then perceived at that point. I have repeated this experiment, but I do not find that the single image cannot be got when the point of convergence changes within certain limits. The same result can be more simply accomplished by a row of strings, with weights on the bottom of them, suspended from a rod. The points of suspension for

[1]Fick, Physiol, Optik, p. 80.

[2]Archiv f. Opthalmologie, XXII., 4, p. 31, and XXIV., 1, p. 27 and 4, p. 47.

any observer may be determined beforehand, by drawing, in the way made clear by Fig. 8. The

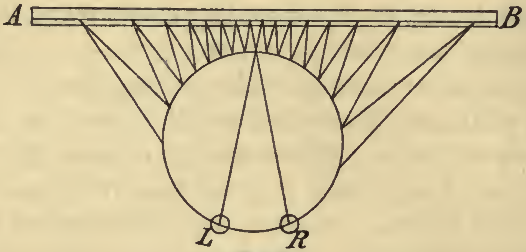

Fig 8.

strip of paper AB is cut off and nailed on to a strip of wood, and the points on it determine the points of suspension for the pendulums. To avoid the error produced by the opposite obliquity of vision of the two eyes, the half strips of paper and of wood should be inclined at an angle equal to the supplement of the angle of convergence (Fig. 9). When the eyes are brought into the right position, the strings can all (with the exception of the two outer ones) be brought into a cylinder of startling reality; after a few moments, their minutest fibres can be seen as distinctly as if one were looking at a cylinder of actual strings. *But it is not necessary that they should be at their constructed distances apart.* If they are hung at equal intervals, for instance, they are just as easily brought in, but they appear then in the shape of a plane. In this way they constitute a form of a well-known and much-discussed experiment.[1] All but the one looked at of the phantom

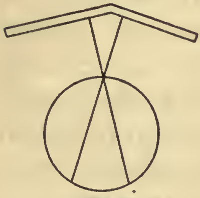

Fig 9.

[1]Hering, *Physiol. Optik*, pp. 398-403. Helmholtz, *Optique Physiologique*, pp. 827-835. LeConte Stevens, *Am. Jour. of Science*, 3, XXIII, p. 298. The slight curvature of the plane appears in the actual strings as well as in the phantom ones.

strings are now seen double, *but it is no easier to distinguish that they are seen double than it would be if they were actual strings.* They may be hung at various slightly irregular positions, and they then form various irregular surfaces, but there is no reason for saying that one rather than another of these various surfaces is a *Kernfläche* (Hering, l. c). It is even possible to set one of them to vibrating from side to side between its neighbors, without being able to perceive that one is seeing double. What happens then, is represented in Fig. 10. As the actual string A moves from *a'* to *a''*, the two phantom strings which it assists in forming make long excursions in and out, as is indicated for one of them by the two small circles of the figure. It is plain then, that the difficulty of making ourselves conscious of what points in space we see absolutely single is not at all obviated by this device. The same thing might be concluded from the fact that it led Schön to see the horopter of points as a circle, and Hering to see the horopter of upright lines as very nearly a plane. That difficulty is quite overcome, however, by such an arrangement as that illustrated in Plate I. I propose to apply it to the determination of the horopteric curve for non-primary positions of the fixation-point.

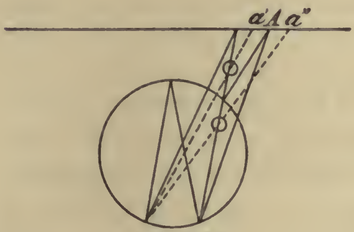

Fig 10.

THE PSYCHO-PHYSIC LAW AND STAR MAGNITUDES.

BY JOSEPH JASTROW, PH. D.

The application of the psycho-physic law to the relation between the estimated and the photometrically measured brightness of the stars has good claims to rank at once as the most practical, most important, most interesting and historically valuable illustration of the significant natural fact which that law formulates. The magnitudes were assigned to the stars at a time when no objective method of measuring the light emitted by them existed, and the stars were thus graded because that seemed the best way of arriving at a roughly quantitative notion of their relative illuminating powers. The eye was used as a natural (psychical) photometer, and now that artificial (physical) photometers rearrange these magnitudes, it is possible and important to trace the (psychophysical) relation between these two photometric scales. In fact, this very relation (with the exception, perhaps, of the physiological researches of E. H. Weber) did most to suggest to Fechner the formulation of his law. As he pointedly remarks, in this field the psycho-physic problem was solved before it was stated.

It will perhaps be well, before passing to the magnitudes themselves, to illustrate by an analagous instance what the psycho-physic relation in question

really means. For this purpose the historically first suggestion of the psycho-physic law, dating from Daniel Bernoulli (1730 or 1731) and elaborated by Laplace, will be the best. Bernoulli introduced into the calculation of probabilities the distinction between the value and the emolument of money. By the first he meant the buying power of the coin, by the latter the amount of the additional pleasure, comfort, etc., the money could bring in any one case. In other words, while a dollar will buy for A as it will for B, C and D the same amount of sugar, or of bread, yet the real value of that dollar will be much more to B than it will to A if B is a poor man and A a wealthy one. If A were to find a dollar on the street it would produce in him only the very slightest, if any, addition of pleasure or satisfaction, while if B found the dollar it would mean to him a very great happiness-increment indeed. To get a proportionately equal pleasure A would perhaps have to gain ten thousand dollars by a rise in his railroad stocks. The notion that underlies these commonplaces is that the amount of pleasure, the import of an addition of wealth, depends upon the wealth already possessed, being greater when that is less, and less when that is greater; and the most plausible supposition is that, *cœteris paribus*, (for one's liberality or avarice, and a hundred other circumstances, can alter this) the import, that is, the emolument, is inversely as the wealth. If my fortune amounts to \$5,000 and my neighbor's to \$10,000, an additional \$500 is worth *twice* as much to me as it is to him; to have an equal increase he must get \$1,000 when I get \$500, in which case our fortunes are increased by one-tenth their whole

amount. Hence "equal emoluments" means "equal *ratios*" of the original wealth. Finally, suppose A has $1,000 and I give him $100; I now want to again so increase his fortune that he feels himself as much benefited as he did by the first increase; that is, I want to give him an equal ratio of his fortune, or an emolument equal to the first. To do this I must give him $110, and to give him a third "equal emolument" I must give him $121; and for a fourth, $133.10; for a fifth, $146.41, and so on. To produce an arithmetical series of 1, 2, 3, 4, etc., equal emoluments, I need a geometrical series of money-quantities, and the function expressing the relation of an arithmetical and a geometrical progression, that converts multiplying into adding is the *logarithm*. Hence we may say that the emolument is the logarithm of the wealth; and by widening the conception of the wealth to the general one of a physical stimulus of any kind, and similarly putting sensation in general for the particular sensation caused by an increase in money, you have the psycho-physic law. The practical difficulty is to *prove* that an increase of stimulus has always the same effect when it forms an equal part of the stimulus already present, instead of assuming it as was done above.

In the stars we have a large number of stimuli of all variations of intensity, and to introduce order into this series we roughly divide them into classes or magnitudes. This classification dates from Hipparchus, (about 150 B. C.), who happened to choose six such magnitudes, to one or other of which every star visible to the naked eye could be assigned. The stars of the first magnitude, by their preëminent

brightness, probably first attracted the attention, and got to be first enumerated; then in a descending scale the second, third, fourth and fifth, leaving all the faintly visible stars for the sixth. The magnitudes were determined presumably with the intention of making as much apparent difference *in toto* between one magnitude and the next above it, as between it and the next below it. That Hipparchus's catalogue happened to be divided into just six magnitudes we must regard as largely a matter of accident; an accident in the same sense as it is an accident that our foot is just 304.8 mm., and not a little more or a little less. With a more delicate eye Hipparchus might have made twelve magnitudes by making each magnitude half its present compass; and, in fact, he indicated in regard to some stars that they were rather larger or smaller than the average star of the magnitude to which it was assigned by the terms *μείζων* and *'ελάσσων*. The point of interest is to see whether the magnitudes presumably thus of equal compass, forming to the mind a decreasing arithmetical series, will have for the photometric quantities of light emitted by average stars of each magnitude a geometrical series decreasing by a common fractional ratio. If this is found to be true, then the psycho-physic law holds, and astronomers must take it into account.

The first notice of the existence of such a ratio and of its determination that I can find is given by Steinheil (1835). Steinheil's photometer has an object glass divided into two halves, and the light of the two stars to be compared is thrown by prisms, one into one and the other into the other half. Both

stars are put out of focus so as to appear as discs by sliding the half objective towards the eye-piece, and the brighter disc is enlarged until the two are equally bright; whereupon the position of the two half objectives, with reference to the focal distance (by the law of inverse squares), shows the relative reductions of the light. For illustration's sake he chose thirty stars whose estimated magnitudes were known, and he expressed the amounts of light emitted by each in terms of one of them. Arranging these in five classes, he finds that there is a ratio by which the amount of light of a star of any magnitude is to be multiplied in order to equal in brightness a star of the next higher magnitude: that this ratio is tolerably constant, and equals on the average 2.831. Fechner's revision of these observations gives 2.702.

At about the same time Sir John Herschel made a similar comparison of stars at the Cape of Good Hope, but concluded that the quantities of light emitted by stars of various magnitudes formed a series of inverse squares, such as 1, $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$, $\frac{1}{25}$, etc. But Fechner has shown that Herschel's own observations really correspond more accurately to a geometrical progression with the ratio $\frac{1}{2.241}$ than to the series above proposed, the sum of the deviations by least squares being 2.719 for Herschel's series and only 2.2291 for the geometrical series. As Mr. Peirce says, "So powerful is this natural influence [to make equal ratios correspond to equal intervals] that even Sir John Herschel's scale, which was conceived by its author to conform to a very different photometric law, really does conform to this and not to the one he desired to follow."

Johnson, in 1851, compared the light of two stars by reducing the light of the brighter (by diminishing the aperture of the object glass) until it equalled the latter, and found as the ratio of light between two magnitudes 2.358 from sixty stars of from the 4.1 to the 9.7 magnitude. Johnson also deduces the following ratios from the catalogues of previous astronomers, and assigned to each an appropriate weight to mark its reliability. He makes for Herschel 2.46 (wt. 1), for Struve 2.61 (wt. 2), which would be 2.41 if he had taken 13 instead of 12 magnitudes as limit of telescopic vision; for Otto Struve 2.46 (wt. 1), for Argelander 2.32 (wt. 3), for Groombridge 2.58 (wt. 1.5), for his own 2.36 (wt. 4).

Stampfer (1852), from the observation of 132 stars of fourth to tenth magnitude, fixed the ratio as 2.519, and from the observation of small planets 2.545.

[Dawes (1851), by a peculiar and much discredited method, arrived at a ratio of 4.00. This has been so unfavorably criticised, and so many sources of error in it have been pointed out, that it will not be considered here.]

Pogson (1857) compared the light of stars by finding the size of the aperture of the object glass necessary to extinguish their light, and concluded that the ratio (from observations of thirty-six small planets and stars) is 2.427; but proposes as the ratio to be adopted by astronomers 2.572, whose logarithm is just .4.

Seidel, (1861) who used Argelander's estimations of magnitudes and photometrically measured 175 stars with a Steinheil photometer, deduced 2.8606 as the ratio, mainly from determination of the brighter

stars. He mentions, however, that the ratio is subject to many irregularities, and that perhaps it decreases as the stars decrease in brightness. Mr. Peirce deduces 2.754 as Seidel's ratio from stars to the 3.5 magnitude.

Wolff calculates from his observations that the ratio for passing from the 2nd to the 2.5 magnitude is 1.52:1; from 2.5 to 3 is 1.53:1; from 3 to 4 is 1.51:1; but 3.5 to .4; 4 to 4.5 and 4.5 to 5 have smaller ratios, on the average only 1.34:1. This gives for the higher entire magnitudes 2.310, for the lower 1.795.

From Zöllner's observations of forty-two stars (1st to 6th magnitude), the ratio 2.761 was deduced; from 102 stars (2d to 6th magnitude) of the same observer, 2.366.

Dr. Rosen's observations of 100 stars from the 5th to 10th magnitude give, according to Peirce, the ratio 2.339, with an indication of a higher ratio for the brighter stars.

Mr. Peirce, from his own observations, deduces for stars (1.5 to 6.5 magnitude) 2.773, but on throwing out certain stars affected by a constant error 2.449 for stars of 4.5 to 6.5 magnitude. Mr. Peirce gives reasons for believing that the Steinheil photometer is apt to make the ratio in question too large. Steinheil and Seidel, who used this instrument, give by far higher values than other observers, and the determination of the same twenty-seven stars gives for Seidel 2.780, for Zöllner 2.4275.

On the whole, Mr. Peirce prefers to consider the ratio as slightly decreasing with the magnitude, and proposes the formula, log. ρ=0.486—.0162m., which empirically satisfies the observations of Seidel, Rosen

and himself. Here ρ is the ratio in question and m the average magnitude.

One sees from these facts (1) that the existence of a ratio by which the quantity of light emitted by a star of one magnitude is to be multiplied to express the light emitted by a star of the next higher magnitude has been questioned by Herschel alone, whose own observations, however, show that he was wrong; (2) that [with the exception of Dawes] the ratio thus found does not differ very considerably from 2.5 in different observers, and (3) that there are many indications that this ratio is not quite constant, but decreases with the magnitude.

Under these circumstances it seemed to the writer well worth while to reinvestigate this ratio throughout the visible scale of star magnitudes from the valuable photometric comparisons which Prof. Pickering (with the assistance of Mr. Searle and Mr. Wendell) has made at the astronomical observatory of Harvard College. (v. Memoirs of that Obs., vol. XIV).

Their method of observing stars was by means of the meridian photometer. The essential parts of this instrument consist in two right angled prisms to reflect the two stars to be compared into the two similar objectives of a horizontal telescope; of a system of adjusting apparatus by which the stars thus observed could be kept in the centre of the field; of a double-image prism of Iceland spar and glass set in the tube near the focus of the objectives, in order to split the emerging pencil from each objective into two, and so adjusted as to make one pencil from one objective coincide with the opposite pencil of the other objective; of an eye-piece through

which the two centrally coinciding pencils pass, in front of which is placed a Nicol with an eye-stop of such an aperture that it will cut off the two outside pencils, allowing only the central one to pass; of a graduated circle attached to the eye-piece and the Nicol. The pole star was always used as the constant star, and an observation consisted in determining the angle through which the Nicol must be rotated from the point where the two lights are equal to the point where the pole star disappears, the relative brightness of the two stars being measured by the square of the sines of these angles. Adopting the proposition of Pogson, that the logarithm of the ratio of light between two successive magnitudes is .4, it is easy to form a table of photometric magnitudes corresponding (to the nearest tenth) to the angles thus determined.

In all, 4,260 stars of from the first to the sixth magnitude were thus observed in 700 series, including 94,476 separate comparisons. The special sources of error avoided by this method are that one star is seen at a time, and contrast with bright neighboring stars is avoided; that the combined light of several stars is never mistaken for one; that errors resulting from the relative position of stars do not occur; that all stars are observed near the meridian, thus facilitating the correction for atmospheric absorption, and so on. (v. original.)

An important part of the work consists in the comparison between these photometric magnitudes and the eye estimates of former observers, with a discussion of their deviations. It is these tables that have been used.

By a simple formula with which Prof. Pickering, for

whose aid I desire publicly to record my obligations, has kindly furnished me, these tables can be transformed so as to become directly useful for the present purpose. That is, the eye-estimations of magnitude of the several observers can be compared with the Harvard photometric determinations of the same stars (or equivalent stars), and the ratio which each observer more or less unconsciously used for passing from one magnitude to the next may be deduced. It must not, however, be supposed that these estimations are entirely independent of one another. There was almost an unbroken tradition which, to a greater or less extent, either determined the estimation of the magnitudes themselves or influenced the habit of those who made new estimations.[1]

The resulting deviations between observers are

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[1] "In Ptolemy's catalogue of stars, which is supposed to date from Hipparchus, we find the stars ranged in six orders of brightness called magnitudes. The earlier observers not only imitated this method of indicating the brightness from Ptolemy, but also, each of them derived immediately from the study of the Almagest and its comparison with the heavens the habit which determined the limit of brightness between stars which he would assign to different classes. This must, at least, have been the case with Sufi and with Tycho Brahe. Ulugh Beg was, no doubt, influenced by Sufi, as well as by Ptolemy directly, and Hevelius was in the same way influenced by Tycho. It appears that down to about 1840, Bayer's Uranometria enjoyed a high reputation. Argelander showed, however, that its magnitudes were simply extracted from Tycho's catalogue [and from the Almagest in most cases, s. Argelander, De fide Uran. Bayeri, p. 15 (E.)], and he himself proceeded to make a Uranometria Nova. It is to be presumed, therefore, that he endeavored to model his scale of magnitudes upon that of Tycho, although he may have sought to improve upon Tycho's scale by making the intervals between the limits of successive magnitudes such as would seem equal. All observers of stars visible to the naked eye since Argelander have sought to conform to his scale. It is, thus, easy to understand how all the observers have, roughly speaking, the same scale of magnitudes. On the other hand the scale of Sir John Herschel, which was based on common English tradition from Flamsted (who perhaps imitated Hevelius, but was a careless observer of magnitudes), is very different." C. S. Peirce, Harv. Annals, vol. IX., p. 1-7, where is also given an ingenious diagram illustrating the differences between various observers.

many, and are, with regard to the completeness of the survey, the total number of magnitudes used, the fineness to which the estimations were made, and the method of making them.

The tables of Prof. Pickering, which are readily serviceable for my purpose, are those comparing the photometric measurements with the estimations of Ptolemy, Sufi, Struve, J. Herschel, the Uranometria Nova of Argelander, the Durchmusterung of Argelander, Behrmann, Heis, Houzeau, the Uranometria Argentina of Gould, Flammarion, the Bonn observations, (Argelander), and of Prof. Pickering himself. Other of the tables there given are also indirectly useful for this purpose.

The total number of estimations thus furnished is very near twenty thousand, all but eighty-five of which fall between the 1st and the 7th magnitude. The estimations of each observer were distributed in a somewhat peculiar manner, there being always an undue number of stars estimated as being just of the 2d, 3d, etc., magnitude than of the 2d to 3d, 3d to 4th, etc., when that mode of estimating magnitudes was used. The rule followed in condensing tables arranged on this plan was to sub-divide them into divisions in which the even magnitudes came at the centre and the intermediate divisions to either side, dividing the exactly intermediate division into two, and counting half for the group above and half for that below, when necessary. Moreover, the average photometric result corresponding to any one magnitude, or subdivision of a magnitude, was weighted by the number of stars observed as of that magnitude; and the stars of intermediate magnitudes were

weighted by half the sum of the number of stars to either side of the even magnitude with which they were grouped, so as to bring the average estimation at exactly an even magnitude. Where the tables were given in 10ths of magnitudes, both the photometric result and the eye-estimates were weighted by the number of stars observed, and the groups formed by taking all the stars from the middle of one magnitude to the middle of the next, counting the number of just 1.5, 2.5 magnitudes, etc., as half for each. The photometric results corresponding to exactly one magnitude of interval were then calculated from the average weighted 10ths of eye-estimation (which seldom differed much from unity in either direction). With the exception of the eye-estimates of Professor Pickering, which were made with reference to the photometric magnitudes as well as with especial care and with the avoidance of many sources of error (and of a few observations by Sir J. Herschel, which have not been here considered), all the tables show one serious and one more or less decided deviation; they estimate stars of the first magnitude too bright. Or perhaps one ought to say that some of the stars of the first magnitude are so intensely bright that they make the average star of the first magnitude much too bright; or again, that the stars enumerated as of the first magnitude really should be sub-divided into two, those of the first magnitude and those few preëminently bright stars which one might term the 0th magnitude. It is also to be remembered that there are fewer of these stars to be observed, and thus greater room for error. A similar but opposite effect is noticed in the fact

that in the six cases in which basis is given for calculating the ratio of 7th to 6th magnitude this ratio is too small; these six ratios present great discrepancies, and the result is not of great reliability. My method of correcting for these errors is to calculate the curve which the other four ratios follow and calculate the positions at the "2-1"[1] and the "7-6" ratio from the formula thus obtained.

Another peculiar irregularity is to be found in the two ancient catalogues of Ptolemy and Sufi. The ratio from "3-2" to "4-3" undergoes only a very slight fall or in Sufi's case even a rise, but in passing from "4-3" to "5-4" a sudden and most decided fall. I see no ready way of accounting for this except perhaps that these observers may have had in mind a general comprehensive distinction between bright and faint stars, and that in the desire to separate the two they made a gap between the 1-2-3 and the 4-5-6 magnitudes. No such effect occurs at all in the modern catalogues. On the whole, as the importance of these catalogues for this purpose is slight, it seemed better to omit the ratios in question, and perhaps it might be best to omit Ptolemy's and Sufi's catalogues altogether, the effect of which would be to slightly lower the resulting ratios.[2]

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[1]The 2-1 ratio, 7-6 ratio, etc., means the ratio for passing from an average star of the 2nd to an average star of the 1st magnitude; from one of the 7th to one of the 6th, and so on.

[2] It should be added that Houzeau's table gives a value for passing from the 6.7 to the 6th magnitude, which I could not use. Behrmann's ratio for 2-1 from only five stars, and the Bonn observation ratio of 5-6 from twenty-two stars were also not used, for evident reasons.

The general average of all[1] the tables here used gives the following table, including all the above corrections :

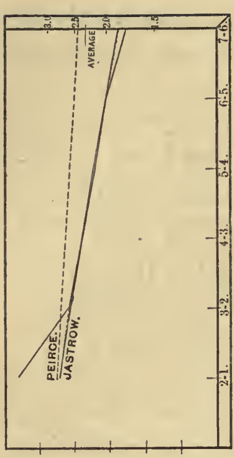
Magnitudes.	2-1	3-2	4-3	5-4	6-5	7-6	Av. of all.
Logarithms of Ratios.	(.5572) Corrected .4474	.4147	.3780	.3360	.3125	(.2501) Corrected .2732	.3603
Ratios....... ...	(3.607) Corrected 2.802	2.598	2.388	2.1675	2.053	(1.779) Corrected 1.876	2.293
Weight, i. e. Number of observations.	288	818.5	1791.5	3746.5	9772	2428.5	

It is evident that the ratio decreases with the magnitude, and the empirical formula thus calculated by the method of least squares that best satisfies these results is log. $\rho. = .49974 - .03486\ m$, or, $\rho. = 3.16\ (.9228)\ m$. Mr. Peirce's results by the same method give log. $\rho. = .48 - .0151\ m$.

The following table shows the divergence between the observed and calculated ratios by my formula. The logarithms are given. It should be said that the magnitude, m, means the mean magnitude, *e. g.*, for passing from 3-2, the value of m is 2.5. As will be seen, the result when we plot the logarithms is a straight line, with a more decided inclination than that of Mr. Peirce. The resulting curve

Observed.	Calculated.
.44745	.44745
.4147	.41259
.3780	.37773
.3360	.34287
.3125	.30801
.27315	.27315

[1]The methods of deriving these averages is as follows: After deriving the (logarithm of) the ratio for passing from one magnitude to the next above in the way already described, all these results are grouped with their approximate weights and expressed in logarithms. The weighted average logarithm for each group, "2-1," "3-2," "4-3," etc., is calculated, and these form the uncorrected series of logarithms given in the table. The reasons for plotting the logarithms rather than the ratios themselves is that the logarithms form the simpler mathematical curve, a straight line, for comparison, and in addition obviate the distinction between the ascending ratios and their reciprocals, the descending ratios.



as well as the theoretical curves of Mr. Peirce and myself are given in the figure, q. v.

It should be added that facts favoring this interpretation of Fechner's law exist in other kinds of sensation; but perhaps not in sufficient quantity to allow of a quantitative determination such as is here made. It is universally admitted that the accuracy of Fechner's law (or Weber's law, for from this point of view the two are simply two different modes of experimenting) suffers a deviation both when the stimulus becomes very intense and when it becomes very slight. A more or less extended intermediate region in which the law holds is generally supposed, and the deviations at the extremes, which are admitted to be of opposite natures, would then form a broken line somewhat like this—

. But it is certainly more natural to suppose that the curve is more regular and can be represented by a straight line inclined throughout. Such is the result which the consideration of star magnitude suggests and formulates. Whether and in what way this result is to be taken into account by astronomers must be left to them to decide.[1] To the psychophysicist this method of testing the law is of very especial interest, amounting almost to a new psycho-physic method; even

[1] The astronomers have generally adopted the ratio whose logarithm is .4, *i. e.*, 2.512, as proposed by Pogson. The average of the above values is .3603 (or 2.293). If we confine ourselves to stars down to the fifth magnitude the average is .39635 (2.492).

though it be one rough in its nature and limited in its applicability. The psychological processes involved in this kind of experiment differ so much from those employed in the more current experimental methods, that a comparison between the two is extremely valuable ; and is made the more so as it is capable of furnishing the grounds of the validity of the inference from Weber's to Fechner's law.

The general conclusion reached by my investigation is that the law regulating the ratio of light between stars of one magnitude and those of the next above or below it, is the psycho-physic law as formulated by Fechner, with the modification, however, that the ratio in question, instead of being perfectly constant, decreases slightly with the brightness of the star, and may provisionally be regarded as following the empirical formula, $\log. \rho = .5102 - .0353\, m.$, where ρ is the ratio of the light of one magnitude to that of the next below it and m is the magnitude intermediate between the two between which the ratio is to hold. All this is claimed for stars down to the sixth or seventh magnitude only ; what the law is for fainter stars remains to be determined.

PSYCHOLOGICAL LITERATURE.

Proceedings of the English Society for Psychical Research. From July, 1882, to May, 1887.

Phantasms of the Living. By EDWARD GURNEY, M. A., FREDERICK W. H. MEYERS, M. A., and FRANK PODMORE. Two Vols. 1886.

The movement out of which the English Society for Psychical Research grew seems to have been Professor Barrett's paper before the British Association in 1876. This was the year in which the experiments of Mr. A. E. Outerbridge became known in Philadelphia, and in which Dr. George M. Beard, of New York, began his publications on muscle-reading. Unlike these American writers, Professor Barrett surmised that muscle-reading was an inadequate explanation of the "willing-game" just then becoming popular in England, especially when the transference of impressions was accomplished without contact, and the older theory of thought-reading seems on the whole to have prevailed. Although the problem termed by Professor Barrett "supersensuous perception," was the vital and chief experimental one, the English Society, at its organization in 1882, had in view the broader object of investigating modern spiritualism generally. The president, in his opening address, declared it "a scandal that disputes, as to the reality of these phenomena, should still be going on," claimed that there was at least a "*prima facie* case for investigation," and warned his hearers that in so strange a field it was only very gradually that all the complicated precautions needed to exclude possible illusion or deception could be learned. Professor Barrett, too, recognized, though not very graciously, Dr. Beard's six sources of errors, and referred to the prejudice with which this subject is usually approached.

Thus far not only the formation of such a society, but the boldness of its plan, with its committees on apparitions and haunted houses, and on the claims of Mesmer and Reichenbach, and the degree to which the difficulties and dangers of the proposed investigation were realized, were all such as to commend it, not only to every psychologist, but to every true and intelligent friend of culture and of religion. While those who regard the baser forms of modern spiritualism as the refined and concentrated embodiment of all the superstitions of a remote and barbaric past, and the claims of those who pretend to mediate between the living and their friends who are dead, as a nameless crime against the most sacred things of the soul, must feel a deep interest in such work, there is another class, perhaps still larger, and with an interest still deeper. This class consists of those who, in these days of unsettlement in religious beliefs, hope to find amidst superabundant *aberglaube* a nucleus of certainty for at least the doctrine of immortality. The most absolute idealists are not so satisfied with the speculative method which works by exhausting thought-possibilities as not to

welcome the most empirical refutation of materialism and mechanism. Even Mr. Meyers's "phantasmagoric efficacy," his "telepathic percolation," or veritable ghosts of those dying or dead, or even in great danger, are not unwarrantable in establishing his "solidarity of life which idealism proclaims," or "the universal mind in which all minds are one." But the impartiality attainable in most fields of scientific research, while it is the ideal to be striven for, in fact is impossible here. A rigorously unbiassed, and yet an intelligent jury, could probably not be found in this country, or in England, so many and subtle and remotely ancestral are the conscious, and far more the unconscious, prepossessions which enter like Schopenhauer's primacy of the will, making us all lynx-eyed to all that favors one side, and bat-eyed for all that favors the other. It is the fact of this inexpugnable bias (which, as has been well said, evolved from a state of savage superstition, so predisposes men that every occasion for it to show itself is utilized, and is therefore dangerous to modern culture and civilization, which enters unconsciously into our judgment regarding all such evidence as seems yet attainable in this field, weakening strong and reinforcing weak proof), that must be constantly kept in mind in seriously striving to form a just critical estimate of the voluminous printed work of the English Society. Even in reiterating the oft-expressed regret that so few men of science, trained in habits of exact observation, to offset the per-fervid and ever-fascinating exuberance of Mr. Meyers, who imposes on his brilliant imagination least of the temperance and suspense bred by the methods of modern science, coöperate in the work of the Society, and especially that trained psychologists and alienists should hold aloof from it, we shall seem to many to express a bias of our own. To these matters we shall recur.

Mr. Creery, a rural English clergyman, had five daughters, who were between the ages of ten and seventeen, in 1882, when the first report was made. Mr. Barrett, who is, we think, a professor of physics, certifies that they were "all thoroughly healthy, and as free as possible from morbid or hysterical symptoms." Their father states that from October, 1880, he had spent "night after night for several months, an hour or two each evening," in experiments on thought-transference with his girls, and seems to have noticed none of the hysterical symptoms, excessive fatigue, dizziness, trancoidal inclination, faintness, *égaré* look, or other pathological effects that alarmed other observers and correspondents of the society who tried similar tests with adolescents. At Easter, 1881, Mr. Barrett was admitted to the family seance. The most meagre account of the conditions of this session are given, and no record was kept of the number of guesses allowed. In August Mr. and Mrs. Sidgwick made a few tests, the conditions of which are not detailed. In November, and again in February of the next year, Prof. Balfour Stewart did the same, and reports his results, stating, however, that "while they cannot stand on the same footing as those of Professor Barrett" and others, they may have corroberative value. In April, 1882, Mr. Meyers and Mr. Gurney tested the girls in sessions covering six consecutive days. In August the three oldest girls went to Cambridge, where experiments were renewed day by day for ten days also by Mr. Meyers and Mr. Gurney, and in December, 1882, Professor Barrett again, alone, renewed tests in Dublin. The percipient power of the children gradually declined during this time, "so that at the end of 1882 they could not do under the easiest con-

ditions what they could do under the most stringent in 1881." This decline, it is later stated in 1886, "had nothing whatever to do with any increased stringency in the precautions adopted."

That the precautions did grow more stringent there is abundant evidence. At first "*all* silently thought the name of the thing selected," after it had been written down and showed to the rest of the family. "The presence of the father seemed decidedly to increase the percentage of successes." At Cambridge, where the three elder sisters were isolated from their family, and where usually none of the sisters but the guesser knew the card selected, the successes were less numerous. Very significant is the series of thirty-two experiments where the sisters knew, and only the tops of their heads were visible to the guesser, and the suit was named correctly fourteen times running, with great positiveness and reiteration, while the card was right but five times. From twenty-seven experiments at Dublin, with the other sister knowing, the committee felt justified in saying that the presence and assistance of the sisters made no appreciable difference in the result, while at Cambridge only eight trials without and seven with the sisters knowing are given as the basis of a similar inference. From these random data the careful reader must infer that the effect of the presence of other members of the family was far from sufficiently studied. Indeed the opposite conclusion from that of the committeee is suggested. The latter expressly ascribed failure under strange conditions to diffidence, and aimed mainly to exclude only *conscious*, and underestimated unconscious collusion, which the long previous practice at home must have made almost inevitable with a set of adolescent girls, however honest or healthy. We should even like a more explicit statement as to how the other sisters were excluded from knowledge of the object selected, where they were, etc.

The methods of isolating the guesser are perhaps still less satisfactory. At first (Easter, 1881) the child was *sent* into the next room, and the name of the object was written and showed around. In April, 1882, the child was recalled by one of the experimenters and movements in the room were excluded after the recall. Later a watcher was sent from the room with the child, and on being recalled the latter was placed with her eyes away from the company. Once at least she was isolated behind the door, at Dublin "behind an opaque curtain" [although we have found an hypnotically sensitized subject who could read large letters in sunlight through five thicknesses of cotton sheeting]. In this most vital respect also there was not only no rigorous control and no systematic method, but only the first rude and irregular preludes and approaches toward it. Such conditions also can serve only to satisfy those present, or with the bias for a pneumatic view of things above referred to.

Again we cannot forbear asking if *every* experiment, without exception, in Mr. Barrett's session of Easter, 1881, to say nothing of Mr. Stewart's sessions, was recorded; and if the results were all noted on the spot and the conditions and descriptions taken at the time and place. The experience of the Seybert commission in these respects, especially the latter, as well as the writer's own experience with the untrustworthiness of memory, even for an hour, where such complex conditions and interests are involved, are sufficient to justify this query. The report of July, 1882, is not explicit on these matters, and, from a careful scrutiny of it, it appears

at least doubtful. When was the paragraph in quotation marks beginning page 21 written, and when the very general description of conditions on page 20? If Mr. Barrett himself made or dictated these notes on the spot, how could he, as the only person present besides the family, possibly so secure himself against all the manifold and subtle sources of fallacy in observation as to be warranted in calling his tests on this occasion "absolutely unexceptionable and conclusive," as he recklessly does. Next in importance to the method of experimenting in so hazardous a field is the way of making the protocol and working up the final form of the report. Either this or the accuracy of observation, or more probably with but one observer, however good, against so many possibilities of error, both must suffer. If either of these surmises is correct, it bears against the statement that the girls gradually lost their power from any cause but increased precautions on the part of the experimenters.

In some of the Creery experiments the precautions of the committee might possibly be impaired by the number-habit, then unkown, and now probably but partially explored, or by corneal reading, or quite broken through by muscle reading without contact of the manifold, and as yet but little known, forms and possibilities which the committee seem to have mainly ignored throughout. We know as yet comparatively little about the constitution and laws of what Dr. Carpenter used to call our automaton. One thing however, is more and more realized, viz.: that it is far more sensitive than our super-liminal conscious sensation, that it is indefinitely more complex and manifold, that no culture has ever approached in its diversity, subtilty or unity the limits of brain possibility in these respects. Neural is far wider than psychic action—the latter involving the former, but not the former the latter. Only when the former reaches a certain intensity, and perhaps extensity, and lasts a certain time, does consciousness, which represents as through a loophole aggregate cerebral states and changes, arise. In the study of hyperæsthesic states we now begin to realize the possibilities of our sensory organism, and how greatly the limits of just observability vary at different times and states and in different persons, and how it responds physically to the remotest and faintest cosmic influences. Hearing, *e. g.*, which is known to vary exceedingly among people whose auditory sensitiveness passes for normal, the writer has carefully tested in many persons. Two individuals were selected for exceptional acuteness in this sense, and the following simple code devised by the writer, which, though repeatedly tried in critical companies, has never been detected, and with results that impressed many as genuinely telepathic. Pulsations, felt subjectively by the percipient, and easily counted by the agent, either by movement of the toe if one leg was crossed on the other, or directly seen in the aorta, or in vibrations of hairs or neck-ribbons, were the basis. The faintest respiratory noises through the nose, or even mouth, of the agent, were made to coincide with and accent certain pulsations of the percipient. To make these modified breathings so distinct as to be clearly heard at a distance by the normal sensitive, yet so faint as to be inaudible even if listened for by spectators often nearer than the agent, was the art of the latter. If a number was selected by some one present the agent caught the rythm of the percipient's pulse, and could hold it for some time if blindfolded, or then see it in the toe occasionally,

and gave a very faint sniff coinciding with a pulsation, and from this, as zero, the percipient counted till the next sniff for the first digit, then till the next sniff from the second digit, and so on. For cards, first the suit and then the card, were counted off. The alphabet went more slowly, but a series of diagrams, from which the selection by the company was made, which had been memorized and numbered, was the greatest success. When the percipient's ears were stopped, coughs, jars on the table or floor, etc., helped us out. This trivial code, however, essentially depended ultimately for the absolute security it generally possessed on the fact that the percipient could hear more acutely than any one present, and when that is the case a telepathy not outside the ordinary channels of sense is possible. We have no data whatever for believing that the ear can hear and distinguish muscle or pencil sounds in making different letters, hear whispers through a couple of doors, etc., but neither have we adequate data for judging how far these, or even less desperate possibilities in the field of vision, would need to be stretched to account for some of the Creery phenomena. Again, a man enters a strange house and wills with the family that a girl in another room bring him certain things in various parts of the house. Would he not almost inevitably in the first session, follow in selecting objects, the suggestions of those who knew what was in the house, and whose mind had been trained both generally from infancy and specifically by the long-continued practices with each other, to concillient action with that of the percipient, and who would moreover not wish her to fail in such an exhibition of her power? When saucer was suggested and written, and plate was brought, the percipient said, saucer "came into my head, but I hesitated, as I thought it unlikely you would name saucer after cup as being too easy," indicating that here, at least, she was controlled by deliberate judgment about the degree of ease or difficulty with which a test was suggested by the preceding one. This suggests clever prediction of the action of minds whose processes are thoroughly familiar—a kind of integrated as opposed to multiplex personality, as in the case of the Siamese and less identified twins—at least so far as the lapse of ordinary associative thought is concerned.

Our chief regret after all is that in the Creery tests the methods were so variable and the results so inadequately worked up and presented, that those whose interest does not centre in the factitious problem of telepathy can get so little aid from them. The poise of a Newton would have even withheld all results till at least some mode or law was either demonstrated or at least disposed of. Is it color or form, suit or card, eye or ear or muscle-sense, that is the preferred medium of transfer? These vital points, towards which we think a truly scientific mind would instinctively tend, are only cursorily mentioned and apparently as afterthoughts. They could best be studied by a careful scrutiny and tabulation of errors which would very likely prove more luminous than successes, and these were not only not printed, but appear to have been only recorded as errors. The color of the card, *e. g.*, ought to be right twice as often as the suit. Were it still more often right it would suggest that transference could be more hopefully sought in the field of color; if one color was chosen most often, that preference would be a fruitful theme for further research, and suggest the kind of precautions, etc. If nine and five are often confounded it would suggest transfer by ear, as in the case of a fleshy and wheezy

agent we heard of whose unconscious laryngial innervation, while thinking of figures and numbers, suggested them to a percipient; if three and two, it might suggest muscle-sense, as the tops of both figures where the hand begins to make them, are alike, so that they are often confounded in muscle-reading, as also are six and eight. If the letters most often mistaken are those shown by Javal's tests to be those with least individuality and most liable to be confused at a distance, in sunlight, etc., we should infer visual transfer. For all such directions of studies, however, or for such data as the experiments made must have afforded had the record been complete and full, we seek in vain. Thus if we conclude, from the very striking results presented, something unknown and independent of consciousness and will, the alternative is by no means necessarily something extra-sensuous or immaterial, or in any degree absolved from the conditions of time and space. So far as this is inferred, we have only another illustration of the inveterate vulgar tendency to associate all unusual manifestations of man's unconscious automatic nature with supernatural powers, whether of good or evil. No special study of such popular chapters of psychology as dreams, witchcraft, hallucination or hypnotism, unless made on the basis of long apprenticeship in experimental biology and physiology and the study and observations of nervous diseases generally, is likely, as it seems to us, to give one that sense of the depth and breadth and number and subtility of physical processes underlying and overreaching and encompassing our conscious psychic activities that is so indispensable just at this point, to prevent an investigation so well begun and representing such high attainment and ability from ending—we will not say as abortively as the other well-known attempts to explain these phenemena made within a century, for it is already far beyond them in methods and results, but without utilizing all the rays of light which modern science now sheds from so many and widely separated points upon the great central questions of psychology. The percipient's descriptions of his mental processes so often adverted to in the reports of the Society are probably of less value than the long account of their symptoms neurotic patients are wont to give physicians who will listen from courtesy and diagnose quite independently of the patient's morbid legend. The degree of reliance on the undoubted good character and *mens conscia sibi recti* of their subjects the committee manifest, despite the irrelevancy of these considerations, which Dr. Geo. Beard has made so plain, and perhaps even the uncalled for allusion to their own veracity and intended accuracy [" The possibility of collusion was excluded unless our own veracity be impeached,"] which are beyond all question, are by no means designed to give hostile criticism an air and sense of personal discourtesy, but are only an irrelevancy expressing the tendency we deprecate.

We have dwelt with some detail on the Creery phenomena because Mr. Gurney, Mr. Meyers and Professor Barrett, the most active workers and probably the best observers in the English Society, spent so much time on them, and because the former expressly states that "it is to those trials that we owe our own convictions of the possibility of genuine thought-transference." Hence a bias certainly existed in all subsequent experiments. The precautions grew more strict, and probably, as we infer, the record grew fuller and more exact, and what is called a decline in telepathic

power we should interpret from between the lines of the record as an approach to the heart of the mystery, which ought to encourage unbiassed investigators to press on toward a beckoning goal. The girls grew discouraged and did not succeed with each other, it is said. This is natural, as interest in their performances diminished. But it is strange that this decline should coincide step by step with closer study of them, and still more so that all the girls should lose this marvelous power *simultaneously!* Never was a momentous discovery wrested from nature with less labor. Groups of agreeable ladies and gentlemen at play sustain each other's flagging interest by the admonition that the sensuous demonstration of the reality of the world of things spiritual and immortal is at hand. "One should not let one's self be discouraged," says Herr Schmoll in the proceedings for May, 1887, "by a little trouble when there is a chance of throwing light on events which, correctly apprehended, may lead us to the psychological proof of our transcendental, imperishable ego." That these investigations have struck the trail of something new and strange, however rare and abnormal it may be, there is ample evidence ; but so far they have given us only the opinions of individuals either emboldened or perhaps formed by very exceptional experience in a field of great popular interest and little positive knowledge, attractively narrated some time afterward with illustrative extracts and a few very summary tables from notes taken at the time.

The second group of evidence for thought transference, next in importance to that obtained from the Creerys is that where forms, often not easily described in words, seemed extra-sensuously transmitted. In the first series of these Mr. Blackburn, an editor, was the agent, and Mr. Smith, "a young mesmerist living at Brighton," was the percipient. They had frequently practiced together previous to their first meeting with the committee in December, 1882. The method was as follows: Mr. Smith was blindfolded and seated with his back to the committee, but in the same room with them. Figures were drawn by the latter, and after Mr. Blackburn had looked at them, and then held Smith's hand awhile, he released it, when Smith drew the figure, remaining blindfolded while drawing, as expressly stated in italics. We beg our readers who may be sufficiently interested to try and draw closed lines, bringing the end to exactly the beginning, as is done in fourteen or more cases in these reproductions, with their eyes closed. We have repeatedly tried and failed with each of these forms, whether drawing slowly and irregularly, as in the earlier figures, or smoothly, as in No. 7. Hence we infer either that Smith saw while drawing, which seemed to the committee as likely, and no more so than that he saw while divining the figure, or else that we have here to do with another mild marvel to which they have not called our attention.

About six weeks later experiments for three or four consecutive days were conducted at the rooms of the society in London with the same subjects, and still another series in April, 1883. In all thirty-seven figures were drawn for reproduction, of which fac similes of twenty-two are published. Of these five were with contact. These, however, and even the first series, we may disregard, as it now became with the committee a "cardinal axiom on this subject that no experiment where contact of any sort is allowed can be decisive." For the remaining seventeen the conditions seem more strict than for any tests yet made. The agent was seated and watched contin-

ually in one room, and the drawings were made in another which the committee did not leave. After seeing the picture, Mr. Blackburn, with closed eyes, was led into the room with his sensitive and placed behind him at a distance of some two feet. The percipient sat and drew with or without bandage as he chose, and the reproductions were at once secured. With the record of these seventeen reproductions, without contact, of the most unconventional diagrams we confess ourselves more deeply impressed than with any other work of the society, especially the remarkable No. 22, reproduced with the ears of the percipient stopped with putty, and wraps enveloping the entire upper part of his body. We can but wish, however, there had been more of these, and consecutively, and that while they were about it the committee had isolated the lower part of Mr. Smith's body from all sensation of jars, and carried, rolled or swung the agent into the room, to exclude the possibility of a code by steps which an American exhibitor has brought to an incredible degree of development, and also tested the amount of reduction of acuteness of audition in each ear of Mr. Smith, or at least of themselves, by putty, and taken precautions to make sure that all light from the floor was excluded from Mr. Smith's eyes. We have practiced with some success a toe-code, a part of which is by minimal movements of the great toe within a thin shoe, the latter not moving at all, and a part, for complex figures, involving slight movement of the toe of the shoe, which we should think would only be facilitated by the conditions of No. 22 with overhanging wraps to shield it from the committee. Moreover, it is just these larger general forms and relations of parts without finer details that are best transmitted thus, while the latter, as the committee note, are absent. It seems worse than Mephistophelean —indeed we wish we were freer from the fear that it is so in very truth—to even suggest, in place of tension toward transcendental entities, slight practiced movements of the big toe. We do believe, however, that the mumber of possible keys and codes by which these things can be done is far greater than the committee seem to realize, and even that very subtle forms of deceit are sometimes automatic and quite unconscious in the most worthy people. The first four figures where contact was allowed are certainly much better reproduced than any other four in the series, and in Figure 13 an entire change of the percipient's conception of the model was caused by contact, though unfortunately it is not stated whether Blackburn touched Smith again after he had corrected his conception of the original, and before it was correctly reproduced, or whether the second reproduction coincided with Blackburn's memory of it. Again, in Figure 6, contact suggested a remote reproduction. Suggestive, too, is the circumstance that after contact was excluded Mr. Blackburn explains so many deviations in the copy into greater conformity with the originals by mistakes in his own conception, which he had done in no previous case in this or the earlier series. A cross in one would grow too large in his mind's eye against his will; he had "not precisely remembered" another; forgot the eyes in another; focused on one part only in another, and imagined curves in the opposite direction in another. The tests to account for the mental inversion of objects, which strikes us as just the thing, were only forty-two in number, the result being that eighty-seven per cent. of the answers gave the direction in which a vertical and only thirty-seven per cent. gave that in which

a horizontal arrow pointed. May we add that we have found the same advantage of perpendiculars in the toe-code, on account of the relative difficulty of lateral movement? This is doubtless entirely irrelevant, for it is expressly stated that Smith sees in his mental shrine the image of a white arrow on a dark ground and instantly detected the change when a white arrow on a red ground was substituted for an ink-drawn one. This aside, however, we deem the evidence considerable that after contact was given up either a new and less practiced or more difficult code (conscious or unconscious) was used, or else that the unknown telepathic forces were obliged to find and deepen other lines of least resistance.

Mr. Malcolm Guthrie, well known as a writer on the Spencerian philosophy, is the centre of another important group of thought-transferers, and the percipients are young lady clerks in his drapery establishment in Liverpool. His first tests had been made upon his son. "a nervous and susceptible fair-haired boy of ten," who was at first very successful, but whose efforts made him "feel queer," and who was soon "disposed to ensure success by taking a sly peep at the object." Here he would have stopped had he not learned of the success of the lady clerks, who had practiced by themselves, stimulated by an exhibition of Irving Bishop. The protocol here is admirable, taken on the spot by Mr. Birchall and printed in full, and Mr. Guthrie is very positive in stating that there were a large number of "complete successes" where "the possibility of indication was excluded." The first session of April 4, 1883, consisted of four tests with contact and blindfolded percipient, and one pretty complete success. At the next session, which was without contact, the ladies alone were present. In the frequent sessions in April and May and the following fall, thirteen in number, with from one to over a score of tests each, Mr. Guthrie and Mr. Birchall were generally present with the ladies. The party sat in a semi-circle facing the percipient, and one, or more commonly all present, acted as agents, gazing at an object placed or held in front of them, but back of the blindfolded percipient's head. The first thing that strikes the critical reader is that failures are put down only as such, whether entire sessions as those of May 25, August 30, September 26, or single tests, while the words of the percipient and the conversation with the agent, showing the approximations to correct guesses, are quite fully given in successes, although here again failures would be probably more instructive, or at least as much so, as successes. The tests were mostly visual, and thus, so far from the process being "independent of the recognized channels of sense," as telepathic processes are defined, they are distinctly in the field of vision. Hence, if the vision was not due to normal retinal stimulus, however subtle in degree, the images must be centrally initiated and projected centrifugally outward and downward, which even Mr. Gurney is bold enough to urge, in the face of a strong consensus of neural specialists only for those of the more elaborated and variable sort. The percipient first "sees" light on dark, and next most frequently yellow, the brightest colors, and very general indications of form follow. The first attempt made to study the effect of colors might, if systematized and carried out, have told us whether the ease of perception followed the law of saturation or intensity, but was so badly arranged as to show nothing. This and much else makes us wish to know how the percipients were blindfolded, but we are

only told once for all that it was "effectually." How many thicknesses, of what kind of material and of what colors; how, if at all, they were tested as to their sensitiveness to light, which may be completely absent at first, but slowly regained in wonderful degree, as experiments show, by rest. We are not told the position of the light, or whether there was one or more, nor whether there were polished surfaces capable of reflection, whether access of light from below was permitted. The writer knows a young man who has given attention to the position and use of tiny mirrors, drawn by hairs or invisible threads from the shoe-sole, pants, etc., to enable him to see below a blindfold what was taking place above and back of him, trying even watch-guards and chains, bright buttons and eye-glasses carelessly hanging from his neck. In such tricks ladies might possibly receive even unconscious intimations from reflecting surfaces of stones in their brooches or rings, or indeed any polished surface capable of sending light under a handkerchief about the eyes. There is little indication that Mr. Guthrie is aware of the number and subtility of the sources of error in such experiments as he conducts. We have ourselves conveyed indications of form to a confederate by slight conscious movements of the eyes. This code is a dangerous one, for the attention of all is so prone to fasten on the eyes, but the law of the dominance of contours and the motor elements of perception shows how unconscious and instinctive it is. With contact we have conveyed form by motions so slight as to tax even Goldscheider's limits of extensive sensibility by a grain of sand glued to the finger-tip, and deliberately drawn a figure on the dermal surface of the percipient by motions so slight as to escape detection. A very simple and rapid pressure code for figures, with almost no lateral motion, is worked with a little practice. Another possibility of error lies in the tests with names and letters. If one thinks of a letter and either says or points to each letter in the alphabet, a good muscle-reader divines what letter is in mind by unconscious and unavoidable modifications of finger or voice when it is reached. In the Guthrie tests a free conversation is held. "Has the word come to you?" says the agent to the hesitating percipient, who responds *z*, which is the last phonetic sound it "has." "Right," says the agent; "*i*" at once says the percipient. After guessing *o* rightly and hearing the word right again, now perhaps without any modification of any of its phonic elements, the percipient murmurs *p* and *m*, and when the agent says *No*, at once responds *n*, which is right. As there is internal evidence by indirect quotations and other ways that we do not have a full stenographic record of all the often protracted, conversation leading up to the correct guesser, suggestions unconsciously given and received of this kind are at least not consciously excluded.

In the report of November, 1883, sixteen reproduced drawings selected from one hundred and fifty obtained by Mr. Guthrie and his subjects are published. The original diagrams were "for the most part" made in another room and placed behind the agent, and later in those published, on the agent's side of a wooden stand on a table between him and the percipient, the latter being blindfolded. When the percipient professed herself ready to draw, the picture was concealed and the blindfold removed. Of the sixteen, which seem to have been produced after considerable practice, and with these more strict conditions, contact occurred

in but three cases, which are reproduced better than the rest, certainly if we exclude the first six complete and consecutive tests of a single sitting. With one hundred and fifty ever so partial successes it would seem that some induction could be made as to the parts of the figure or the forms that were best or worst reproduced. In those printed angles are nearly always retraced by the percipient. The same is true of curves, especially circles, with which angles are never confounded, although curves are repeatedly given in the wrong directions. It would seem that vertical were quite well distinguished from oblique or horizontal lines. A straight vertical line is drawn with a crescendo and then a diminuendo of rate, as Vierordt's experiments show, and also of pressure and of noise, as experiments with a spring pen on a large rotating surface made in the psycho-physic rooms of this University showed. Such a line is readily distinguished from a curve by the ear alone. A gradual change of direction involving new sets of muscles, a single movement in one direction, a sudden change in direction, series of repeated movements, large and small lines of the same sort, heavy and light, etc., are not hard to distinguish. A few tests with such a code, as near to nature as we could make it, have at least convinced us of possibilities, and we commend it as a subject for further special research as a kind of psycho-physic auscultation. This does not explain to our mind by any means all in all of the sixteen reproductions of this series, but we should like to know how these exceeding broad and scratchy lines of the originals, which are reproduced indifferently, now in very heavy and now in fine lines, were made. Such a suggestion, however, may after all only serve to divert attention from some entirely different mode of transmission.

In July, 1885, Mr. Guthrie reports further researches, assisted by Professors Lodge and Herdman, but complains of a falling off in the success of his experiments, shown also in his tables. One percipient had been lost, the novelty and vivacity of their seances he said was gone, and he had lost power to give off impressions. Whether the percipient had lost power he does not know. The professors do not appear to have made the precautions much more effective, although they placed the percipient blindfolded facing a corner, and placed objects on a screen at the back of her chair which were seen from behind by the agents. We are not told the position or number of the lights, the nature of the screen, the reflecting quality of walls or floor, what precautions were taken in placing and removing objects. Suppose the screen to be metallic or resonant, or even hard, or the objects handled without care not to hit them against things in a way to produce noise, then we may have suggestions by sound, as in the well-known game of guessing any one of a dozen objects by their sound when struck, which a well-known philologist thinks the primal origin of names of objects. Were precautions taken that no floor shadows of the object should be cast, and has Mr. Guthrie ever tried that other parlor game, once very popular in this country, of holding up objects at a distance of from a few feet to a few inches (according to the sensitiveness of its agent), from the face and neck, to be guessed by their differences of radiant heat? Surprising facility in this latter game we have known to be gradually lost by fatigue or consciousness, as with these subjects. In the ease with which colors are divined, especially if bright, the repeated substitution, in objects not well

known, of contours for surfaces and of surfaces for solids, all suggests, as one of Mr. Guthrie's subjects insists, real vision, and not a mental impression by thought alone. This circumstance, and the continued phenomenon of inversion of right and left, and of reminiscence, or late effect of a previous figure, seem to us very suggestively to invite further special research in each direction, which was not attempted.

Professor Lodge makes an independent report on his "some dozen sittings" with Mr. Guthrie's subjects. Like several physicists with whom we have conversed on this subject he conceives the relation of mind to brain as very likely analogous to that of electric energy to the conductor, as not confined to its contour, but exerting an influence "like a faint echo" in adjacent space, and so perhaps affecting other near brains, but so slightly that they do not commonly notice it. He says that no reliance was placed on or care taken in the bandaging, but he shows, although in a strange field, the training of a man of experimental science by the valuable suggestions of two agents, thinking at the same time of a different object, and again of two percipients and one agent, but neither was fairly tried.

Of the tests made by J. W. and Kate Smith, and by Max Dessoir, both, but especially the latter, are not only poorly reported, but seem to have been made with so inadequate a conception of the sources of error, that, although we are assured that "deception conscious or unconscious is altogether out of the question," the indications are, to our thinking, quite otherwise, and their reports of their accounts do not merit detailed criticism.

The tests made by A. Schmoll, translated in the proceedings of May, 1887, are decidedly more striking, but the eyes of the percipient were very slightly covered, merely, it is said, to make direct vision impossible; real objects were handled, and figures drawn with a match dipped in ink in the room, the time required to divine the object was very long, often fifteen minutes or more; the original drawings were not preserved; it was not even noticed at the time whether a watch, laid on the table to be seen by the agents and divined by the percipient, was going at the time or not (the notes stating that the ticking would be drowned by the noise of carriages in the street, was too far off, etc., but Mr. Meyers states that M. Schmoll had proved afterwards that it was not going at the time); all present generally acted as agents, so that no one was left to observe the percipient. The jar of heavy carriages referred to, while it would obscure sounds, might rattle some of the objects lying on the table, and thus suggest, by audition at least the tea-pot. Of the twenty-six experiments reported, some must be called complete failures, and it is a matter of individual judgment to say how many approach precision, which the experimenter claims for but eight.

The above experiments of visual form and hearing are, as Mr. Gurney says, by far the most important and convenient. The tests with tastes and smells, the latter of which is practically almost inseparable from the former in the case of many substances, were usually with contact; but even where the substances were kept bottled in another room and the hand of the agent applied to the percipient through a sliding trap in the wall, we are not even told by whom or just how the substance was applied to the senory surface of the agent. The experiments of Vintschgau and of Camerer, to

say nothing of Jäger, show such subtility of smell with flavors and aromatics that we need hardly assign more than great sensitiveness, hardly amounting to hyperosmia or hypergeusia, to account for all that is reported in the field of these senses. Pains again are so closely associated, by such subtle reflexes, with motor reactions or tendencies to the same, as was experimentally shown in the well-known demonstrations on the reflex frog in Ludwig's laboratory by Baxt, and, as Mr. Gurney pertinently adds, are readily applicable only to a few widely separated tracts of dermal surfaces, that muscular suggestion is almost inevitable, and we think by no means excluded in any of these tests.

We have thus very hastily reviewed all the leading experimental work of the society. Mr. Gurney states that "from an evidential point of view" the facts are "of an extremely simple kind," and Dr. Morton Prince, of Boston, gravely says that "no physical experiments in the laboratory have been more under the control of the chemist and the physiologist than have these." The simple conditions of experiment are, it is said, to exclude unconscious guidances and contact. The exact opposite is true. The conditions are as infinitely complicated as the psycho-physic constitution of man, and the sources of error are as much more numerous than those in physical science as man is more complex than the substances and forces it studies. What individual can catalogue all the scattered known sources of error, to say nothing of those as yet unknown, in this vast field? Fallacies of observation, of evidence, of language and statement, defects of character and heredity, tricks of our automatic nature, subtle and manifold far beyond all conception, the countless possibilities of illusion conscious and unconscious, so great as to suggest that the boast of the great French magician that he would agree to make any man believe in the normal state that he saw anything, may not have been so very wild; the unfathomable passion for deceit, both conscious and unconscious, that sometimes runs in veins through the natures of men of best reputation and most honest purpose—all these and many more are involved and must be exhausted before telepathy can be positively demonstrated as a residual fact. Hyperaesthesia, too whether normal or morbid, opens up a new world as truly as the microscope or telephone. One tells the form, substance and even color of objects near him by radiant heat, or reads as in a mirror, shadows from walls that seem to others unreflecting; or, in one lately reported case, sees the shadows of heat vibrations over a hot substance cast on a wall by moonlight; the sense of a personal presence is felt by the blow or noise of breathing or heat. The case of Dr. Taguet's patient, who, it was said, was able to read script held behind her head by reflection on a plain card in front of her; the case reported by Dr. Sauvaire, who recognized the suit and number of a card in a different pack, as, it would *seem*, by seeing through it; the case of Rocha's clerk, who seemed to use a piece of card-board as a mirror in which he could see all that took place behind his back; and the well-known case of Bergson's reader of images reflected in the cornea—all these cases are very inadequately considered by Mr. Meyers. If these degrees of hyperæsthesia, normal or even hypnotic, are possible, and were possessed by the subjects with which the English society experimented, the entire experimental basis of telepathy vanishes. Moreover, there is a wide field of unexplored possibility. If blinded bats avoid objects in flying by fine sense of greater barometric pressure

near objects, we may reflect on the possibilities of perception of aerial pressure by highnly sensitized subjects. We have no less good reason to complain of the very inadequate way in which the society has treated the subject of suggestion. We regard the book on this subject by Dr. Ochorowicz as one of the most valuable contributions in this field, as the best statement of the chief rival hopothesis of telepathy, and the one we think every truly scientific man must prefer so far; but the treatment of its contents by Mr. Podmore is very light, illustrating again, in fact, the easy way of ignoring serious difficulties and objections which characterizes the society. Then there are codes and signals, and sometimes quite elaborated languages, by steps, inflections, accents, intervals, rustles and movements of every mobile organ. Thus, not only by the arts of diverting the attention, which, if it is sharpened in one direction, is dulled in all others, but even in the very focus of attention the man of sharper can do what he will to and with the man of duller sense, and seem to work by forces "independent of the recognized channels of sense." Add now the extreme rarity of all those qualities of mind which make a good observer, and the strangeness and perhaps great rarity of the phenomenon, and the probability of error in so hasty conclusions is vast.

Dr. Prince states, as is often implied in the reports, that "no established law is controverted" by the conclusion of telepathy. But the law of "isolated conductivity" formulated fully by Johannes Müller, which Helmholtz compares in importance to the law of gravity, first brought order into the field of neurolgy by insisting that impressions never jump from one fibre to another. If the law be true, an optical impression of the highest intensity may pass along centrepetal retinal fibres within less than a hundredth of a millimetre of an auditory fibre without in the least being able to affect the latter. This law is so generally accepted as fundamental that Gudden states that "in the presence of an anatominal fact, all physiological facts that seem against it loose their significance." Indeed, two severed ends of a fibre cannot be put into so close contact that physiological action can pass from one to another unimpeded. Even those physiologists who admit that certain phenomenon may possibly be explained by the old theory of "sympathies," caused by a stimulus jumping across from one fibre to the next, admit that it is both rare and morbid. The oft-trusted illustration of magnetic induction certainly is not valid here. Is it likely that a neural state should jump from one brain to another, through a great interval, when intense stimuli on one nerve cannot affect another in the closest contact with it. An American essayist at a scientific club lately claimed that all associative processes, by which one idea or impression calls up the sequent state of consciousness, are cases of telepathy within the individual brain. But however long the steps that thought may take in the rythm pulsations by which it advances in brains of looser and coarsely woven tissue, it must now be always assumed to imply uninterrupted contunity of neural texture.

Even the fundamental theory of Bell has to be modified, so far as the brain is concerned, to meet the exigencies of the telepathic hypothesis. In Mr. Gurney's scheme of hallucination, centrifugal projection, or escape downward, may even be from the cortex through the basal ganglia to the peripheral organ. Qualified forms

of projection have been often assumed, but the matter is so complicated and so under dispute, that despite the strong light shed by Kandinsky, of whose chief and latest work Mr. Gurney has not taken account, we cannot see that the centrifugal theory of projection along sensory nerves can be proven, nor is needed. It involves the possible blocking of sensations in the *corona radiata*, does not take account of the fact that strong ideas do not usually excite hallucinations, and that as Galton has shown, great men are not prone to mental images. Impressions upon the senses may take on the psychic quality wherever they will in the passage inward to the cortex, one thing remains probable, viz.: that the more central the origin of impressions the more complex it is, and the more peripheral and sensuous the less attendant concepts there will be, the more the logical connection will be broken through and the less sense of inner activity there will be. More attention should have been bestowed to this point, with all the above tests and subjects. So far, however, as the phenomena are described or can be inferred, they indicate the same field of vision as real things, and suggest nothing akin to imperative ideas, projected sensations of central origin, rather than any subjectively created, or critically evolved sense of objectivity.

Very instructive is the experimental investigation of Mr. S. J. Davey on the errors of observation. He was some years ago nearly convinced of the truth of spiritualism by some sad and strange experiences, but was happily saved therefrom by learning and becoming very expert in a few tricks, especially that of slate writing. Assuming a professional name he gave seances to many intelligent people, requesting them to write down exactly what they saw. Many of these descriptions are published in a very long article in the proceedings for May, 1887. The sitters "never detected the *modus operandi*," and their conjectures about it are ingeniously diverse, and illustrate in many cases a strong propensity to a miraculous explanation. But the strangest thing of all is that we are not told how the trick was done, so that we have no point of departure from which to measure the amount of errors with each guesser. Whether it be that the love of mystification is stronger than the love of science with Mr. Davey, or whether he is under obligation of secrecy, which he does not even deem it necessary to state, his attitude is yet that of a conjuror pleased with his trick and the sense of human gullability it gives. A scientific man states the method by which he got his results; not so Mr. Davey. The society professes to desire to protect men from the common delusion in this field. In our judgment nothing whatever does this so effectively as explaining to them the method by which a few common effective illusions are produced. The acquisition of power to do these tricks it is easy to see was what saved Mr. Davey himself from the abyss of spiritualism, against which it is the most potent prophylactic. The trick-books do not retail the kind of illusion here involved, the conjuring business, if it is so desirable to save it, would not be injured materially. Spiritualists will persist, at least, till details are explained, that Mr. Davey is mistaken in thinking he used only natural means. It is almost impossible to exhaust the various methods by which some of the leading tricks are or may be done, but a good collection of descriptions of methods by which a few tricks most closely connected with the phenomena of spiritualism are done would, we think, in the end be the most effective of all disillusioning agencies.

Again, the theory of probabilities is perhaps the most instructive part of the modern logic of science, but the use made of it in these reports we regard as utterly misleading. Mr. Gurney even goes so far as to state that "the argument for thought transference cannot be expressed here in figures, as it requires 167 nines; that is, its probability is far more than the ninth power of a trillion to one." Has he forgotten the obvious truth stated by Mr. Edgeworth, in the first of his valuable papers, that the calculus of probabilities "is silent as to the nature of the agency, whether it is more likely to be vulgar illusion or extraordinary law." "This," he adds, "is a question to be decided not by formula of figures, but by general philosophy and common sense." M. Sorel well says that it is indispensable to consult experience frequently to know if the phenomenon can be sufficiently approximated to the ideal play of chance, as even games of so-called chance are not just applications of the theory of probabilities, though commonly thought to be. In the face of this commonplace we are obliged to say that the way in which appeal is so often made to this theory is the only thing in the work of the society which seems to us lacking in ingeniousness. This aside, however, there are other interesting incidents in these researches that shed light on the general applicability of this theory. Everything runs in groups. There is the Creery, the Guthrie, the Schmoll group, and, as Mr. Guthrie says, "the good averages run in lots," and he thinks that the calculus of probabilities does not help conviction, adding that one successful evening, when the conditions are good and the truthfulness of the percipient genuine and simple, is a better guarantee than any subsequent cross-examination of results. A friend of the writer missed in guessing the numbers of a die the first thirty-seven times, and if there had been as much interest in finding errors as successes, the former may have been as strangely grouped and bunched. As in games of chance, and in the records of gambling houses, there would seem to be as great individual marvels of bad as of good luck, did not the former always tend to be eliminated. In fact we have spent much time and labor in repeating with many subjects, nearly all the experiments of the English society, only to find in very many cases an unaccountable proportion of error. In many of these tests, at least, conditions are not known—not controlled—and the numerical basis needful for a fair average is not established, so that we do not know what "absolute chance" means in a given case, or what was the original *krasis* of things, what is the average error, or how errors are grouped. There is a sense, too, in which the probabilities against any given occurrence are infinite.

These points need fuller treatment, but we must hasten on to note the fallacious conception of evidence in such a field. Much is said about "spreading responsibility," the "cumulative" nature of the proof for telepathy, increasing the number of people who are knaves or idiots if it is not true, and the multiplication of instances is compared to increasing the size of a bundle of faggots, each one of which is easily broken, till together their evidential value is irresistible, and, last of all, prizes are offered for good tests, etc. In a word the society's conception of proof is quantitative. This is an imposing argument in America. When we are told that seven million children are following the Union Sunday-school lesson course, when enthusiastic spiritualists claim still more than that number of believers in their doctrines in this country as proof of pedagogic or

doctrinal merit, we reply that evidence is to be weighed, not measured by bulk. Quality of proof should be chiefly regarded in such matters as psychic research, and not quantity. If one-half the people in the world accepted telepathy and the other half rejected it, it would by no means follow that the probabilities pro and con were even. The cumulative method has the advantage of encouraging the bias above referred to both by mutual countenance and evidential appearances, but in science it is the competent minority that is usually right and the majority that is usually wrong. One man who would exhaust all the resources of modern science in precautions in this field, would be more authoritative than all the parlor sceances together. What is to be chiefly desiderated is not the multiplication of instances, but more systematic and prolonged study of such cases as have been already found, the use of more cautions against error, the probability of which would be shown so incalculably great could the calculus be intelligently applied to their estimation.

Next to the fundamental assumption of telepathy in this class of cases we regard as the capital error of the society the association of the above so-called "experimental basis" with that class of phenomena illustrated by the seven hundred and two weird tales in the Phantasms of the Living, or with "spontaneous telepathy" at a distance. Mr. Gurney frankly admits here "a certain gap" or "incompleteness in our transition, which must be admitted without reserve," and yet elsewhere says it is impossible to tell whether he would have credited the validity of telepathy in the spontaneous phenomena had they not been confirmed by the "experimental basis." In the latter cases will and attention were involved to such an extent as to effect the robust health of Mr. Guthrie, and in the former cases consciousness is less involved. Mesmerism at a distance brings in other factors too abnormal to really constitute a transitional case. While spontaneous cases seem to occur at different distances, from a few feet to thousands of miles, no serious tests of the effect of time, or even distance, strange as it may seem, were made in the experimental cases. Mr. Creery thought that his daughters were most successful at the distance of a yard or two, and a few very inconclusive tests as to the effect of distance were made upon Mr. Smith, but there appears to be no reason to infer any experimental results save at very small distances, (if suggestion and trance is excluded), while for these distances the time seems to vary, with no suggestion or search for a cause, from an instant to fifteen minutes or more. To us the most natural and obvious inference, which is certainly not excluded, seems to be that the two series of cases are due to entirely different causes, no more related than are coincidence and collusion. Again the experimental results were chiefly in the field of the higher senses, involving special forms, and are matters of utter emotional indifference, while the spontaneous cases, which, indeed, sometimes touching the nadir of triviality, as in ghosts of clothes, warm water for shaving, etc., are mostly such as profoundly involve the affections, like death and danger of friends. The collection of tales is of the greatest value, and it is significant that it is the last moment of this life and not the first of another that seems to have most of Mr. Meyers' "telurgy." But we believe the final verdict of science respecting them will be that they illustrate the great mythopoetic tendency by which fancy unconsciously grows into similitude with fact, just as

organisms adapt themselves to their environment, a tendency that is rather to be sought below the threshold than "above the upper horizon of consciousness," as Mr. Meyers believes. The only psychological explanation we can suggest for the premature and almost passionate identification of the experimental and spontaneous cases as telepathic is the constraint of the potent but secret bias in favor of "superconscious" states, of a "soul-politic," or perhaps even "molecular meta-organisms," and in general toward "the solidarity of life, that realism proclaims." But this is surely the idealism of a Swedenborg, and not that of Plato or Hegel.

It illustrates, in contemporary form, Kant's "Dreams of a visionary explained by the dreams of a metaphysician." Our experience, in fact, is not unlike that of Kant, who, after paying a great price for the chief work of Swedenborg, and spending much time in its perusal, concluded, in substance, in his well-known article of the above title, that such pneumatological conceptions were pseudo ideas, formed by the negation of sense, made thought free from not *in* the world, and were idola illustrating the *morbid* tendency of some minds to come to a focus outside of themselves, and that for his part he would henceforth turn his back resolutely from the seductions of such considerations.

When we reflect how few are the well established facts that are exact and certain, and on the labor by which they were demonstrated, or on how rare are well ordered cohesions of thought or the associations that approach anything like real mental continuty, and on the inestimable educational value of these in making possible even a limited area of well woven mental tissue, and remember that modern science is already the greatest achievement of the human race, to bring one solid contribution, to which individuals are more and more content to spend a life of labor, we are reminded of Kant's well-known simile of an island surrounded by an unknown and very tempting, but foggy, stormy sea. In this sense telepathy is of the sea and not of the land. It is, on the whole, much less removed from modern spiritualism than from true science, so far as all telepathic theories go. Spiritualism, in its more vulgar form, is the sewerage of all the superstitions of the past. Wherever there has been civilization and culture, it is because its dark clouds have lifted for a space. It is the common enemy of science and true religion. It has led astray many able men. The beginning of science and philosophy has always been doubt of its claims. The majority of men, living and dead, are its adherents. It is against its claims that skepticism has its leading justification. To clear up its dismal jungles, and drain its unwholesome marshes, is probably the work of centuries. In modern biology, culminating in neurology, where so many of both the secrets and the revelations of science are coming to centre, that one might almost say the undevout neurologist is mad, a firm foothold is at length secured in which mind and matter, so long and so widely divorced that from the fallow between them wild and unsightly growths had waxed strong, and thick, and old, have a common interest, and the dangerous chasm between them is slowly closing. Physicians appeal to the imagination in desperate cases with bread pills and placebos, are less ashamed of interest in hypnotism and are less disposed to regard even hysteria as the *summum incognitum*, and the study of insanity as worthy of the briefest of all courses in medical schools, while clergymen and metaphysi-

cians, on the other hand, who used to practice healing arts in the good old time, when "Godlike was the doctor, who was also a philosopher," are beginning to take some interest in the body, and to read books on mind cures, and psycho-physics, hygiene and physiological psychology, and to realize that the student of religion and of idealism cannot, with impunity, neglect the study of the common forms of morbid psychosis. We desire, for our part, to see the psychological movement, which now seems destined to mark the present as the psychological, as the last quarter of a century has been the biologico-evolutionary age, kept in the severest sense, experimental and scientific. The dangers and difficulties are vast, and the specious false ways many, but we have a nucleus of solidly established facts, and the reward of every achievement is likely to be at least no less than any that have crowned the progress of science in the past. But we must ever remind ourselves that while "strange things are true, they are not truly known till they are related to what is tested, else they remain solitary and unfruitful."

Great credit is due the English society for calling attention afresh to the mysterious side of human life, and for later making known to English readers something of the valuable work of the French investigators of Paris, Nancy, etc. Mr. Meyers has taken great pains to see many of these men and their work. If good hypnotic subjects are more numerous in France than in England, it would seem that ghost seers are most common among cultivated classes in England. It is to be hoped, however, that the indication of more independent work in the study of abnormal states now apparent will lead to more solid results, and that the crude and premature theory of telepathy, which is by no means impossible, *per se* in some sense, but as yet lacks everything approaching proof save to amateurs and speculative psychologists will be allowed to lapse to forgetfulness. To the careful and patient experimenters and observers in this field there are now far better and far surer and far more useful results than these, though by methods far harder and slower. But it is by these that we prefer to labor.

Psychology. The Cognitive Powers. By JAMES McCOSH, D. D., LL. D., etc., President of Princeton College. New York, 1886. Pp. 245.

Introduction to Psychological Theory. By BORDEN P. BOWNE, Professor of Philosophy in Boston University. New York, 1887. Pp. 329.

Psychology. By JOHN DEWEY, Ph. D., Assistant Professor of Philosophy in Michigan University. New York, 1887. Pp. 427.

The work first on the above list is to be supplemented by another on the motive powers of the mind, including conscience, emotions and will. The cognitive powers are here treated in three books as respectively presentative, representative and comparative. Dr. McCosh has taught psychology for thirty-four years, and compares his work to Uncle Toby's stockings, darned till hardly a thread of the original fabric remains. The book is neither dull or dry, but abounds in apt quotations in prose and poetry, stories, illustrations, sudden and unexpected but always impressive morals and hortatory passages, and seems to reflect, in the clearest and most direct way, the strong and beneficent personality of the author, not only

his convictions, but even very many incidents from his own experience being interspersed. Almost every page contains taking points admirably presented to catch the wandering attention of listless students in non-elective classes. The book is of value to every thoughtful teacher of this subject for its pedagogical suggestiveness. It is evidently made up of three factors: General matters of miscellaneous sorts, which, in an unusually prolonged experience as a teacher, its author has found effective and beneficial with the average college senior; the essential points in the Scotch philosophy, or more particularly in Thomas Brown, Stewart, Butler, Macintosh, Abercrombie, A. Smith, etc., which have survived from a long-ago study of these writers; and, thirdly, such material in contemporary psychology as in some cases its commanding importance has brought to the attention of every eminent administrative educator, and in other cases such as mere accidental or personal relations (as with his distinguished pupils, Professors Macloskie, Allen Starr and F. M. Baldwin), have impressed upon the author's mind. That with his advanced years, his heavy educational cares and responsibilities so vigorously borne, and his early absorption in the Scotch philosophy, the limitations of which those who most directly inherit its traditions now best see, Dr. McCosh should have maintained a mind so open to so many of the newer influences in the rapidly widening field of psychology, is a striking illustration of the beneficent effects of the true spirit inbred by studies in this domain, and makes the task of the honest and friendly critic particularly unpleasant. Judged from a scientific standpoint, however, little that is good can be said of the book. The wood-cuts of brain and sense organs that are inserted are but little more related to the text than the marginal figures with which ancient missals were illuminated were wont to be. It is perhaps something to associate the study of perception in the old abstract fashion with even the pictures of these things, although but in the most casual way, as we associate a book with the tree under which we read it. There is an apparent incommensurability between seeing, feeling and thinking on the one hand, and the visual and tactile image of the corona, corpora and vermicelli of the convolutions, on the other, to the novice, that even mere juxtaposition may alleviate. Symbolic figures like the onden of Mr. Betts or the pyramid of Dr. Hopkins, or the circles of modern logicians, or current diagrams illustrating aphasia, etc., have obvious illustrative value. The relation between thought and brain, however, is anything but obvious. but appears more plainly as the anatomy of brain and analysis of psychic processes become finer. It is far less, and perhaps not all by virtue of its morphology, but rather by virtue of its finer anatomical and chemical properties, that the brain is the organ of psychic activities, as yet but imperfectly unknown. This, we believe, should be carefully indicated, or else the anatomical part passed over, in elementary teaching. Many of the allusions to finer structures and processes by Dr. McCosh are inexcusably careless, to use no stronger terms. We are told that "all along the spinal column there is automatic action which is reflex." "There is a cell called a ganglion into which one nerve enters and from which another goes out." Questions of structure are referred to physiology. The communication from the spinal cord is "up by the medulla oblongata and the crura cerebri to the corpora striata and optic thalami." "The action to the brain travels at the rate of 140 to 150

feet in the second. The action from the brain travels about 100 feet in the second." The author hastens on through this strange region, which is dismissed with a caution that all materialistic ideas must be left behind, despite the temptation of youth to the contrary in the study of psychology. "We are not to allow ourselves to look on mind itself, or any of its operations, as occupying space, as extended or having figure, as having weight or levity, height or depth, elevation or depression, attraction or repulsion, solidity or elasticity, motion or rest, light or darkness, warmth or frigidity." Even words derived from material objects, as idea, psychic, spirit, feeling, emotion, impression, understanding, conception and apprehension, must be stripped of materialistic associations with their etymologies. But why then the anatomical illustrations, which not only precede, but follow? Why then the skin with its "two layers," and the nerves in the tongue, fingers and lips "generated at these points by use," and "the muscle sense, including in it the volition and the resistance which first gives us the idea of Power, Potency, Energy or Force, out of which proceeds our idea and conviction as to causation?" Why are we told that "distinctness of vision requires that objects shall be so far apart that their images on the retina shall reach more than one cone?" Why, apart from the many such inaccurate or mistaken statements, is space given to the anatomical and physiological relations of aphasia, memory and association, etc.? Still we are thankful for the good will towards scientific psychology, and commend the sagacity that sees its importance, even if the former be as yet all unreconciled with the traditions of the intuitive school, and the latter uninstructed in details.

A still more grave defect of the book is the essential failure of the author to profit from both Greek and German philosophy. There is abundant evidence here, and in his other works, that he has never taken the trouble to acquaint himself, in any historic or sympathetic way, with the great writers in his field in both these languages. He elsewhere declares that idealism has no place in philosophy, and that the latter will never be properly established till this is acknowledged, but pleads for the old Scotch "realism," as the ideal "American philosophy." As the Scotch school may be said to represent hard-headed common sense, without the refinements or subtleties that are bred of specialized research, by any set method or direction, this is a most convenient attitude for a busy man, who must keep up the semblance of philosophy on short allowance of time and information, and must commend itself to many practical American minds who cultivate the power to make summary snap-judgments on all topics, finite or infinite. We believe, however, that blindness to the great lessons of historical philosophy involves the gravest loss to students. A course in idealism, as treated by Kant, whom our author cannot abide, Plato Hegel and the rest, we believe, stimulates the development of mental power, gives inner resources against all corroding pessimisms, tact to solve the practical problems of life and mind and zest, breadth and insight in any intellectual career unsurpassed if not unequaled by any other element of modern education. It especially illuminates religious sentiments, and gives both poise and a repertory of weapons against doubt, and ought to be entirely indispensable to all who would speak and be heard on religious

topics. That Dr. McCosh, with his great and long opportunities, has failed to utilize these deep sources of wisdom, we regard as deplorable for the real interests of religion, as well as of science. This, we believe, will be the verdict of those laborers in the philosophic field most nearly in sympathy with the religious standpoint of the author.

Once more there is often a dogmatism and self-assertation which is only calculated to entail prejudices and seriously to limit the unfoldment of mental power and future effectiveness. After stating that man's knowledge "begins not with relations, but with with things," he adds, "in laying down this proposition, I undermine one of the most fatal—as I regard it—errors of the day." After saying that the infinite is both beyond our widest thought, and that to which nothing can be added or subtracted, he says: "After working out this two-fold aspect, I found that I had been anticipated by Aristotle." The great problem whether we are conscious of all our mental operations, is dismissed with the statement, "I hold that we were conscious of the acts at the time, but that they were not retained, as there was nothing to fix them in the memory." Again, "I do not agree with the theory of those who ascribe the creations of genius to unconscious mental action." Each of these is a commonplace view long current in philosophical literature, but is stated dogmatically and in the most momentous manner, without facts or arguments to sustain it, as if it were a great and original discovery. Thus he concludes "we have traced the powers of intelligence from the lowest to the highest, and have shown how our cognition and ideas arise." This modest claim is hardly calculated to encourage further study in this field. The book abounds in irrelevancies and discontinuity, and is of all grades of merit, from the extremes of garrulity to very impressive hortatory perorations. Had it been clearly recognized that the problem was to write an attractive primer in psychology, bringing together only the results most universally assented to, and of most practical importance, and pedagogically first, the book, with some material and many minor changes, might have been made commendable. Teachers who introduce youug men, seniors though they be, into these studies, must expend their wisdom in showing where to begin, and shunning the inculcation of a sense of finality, furnish incentive to those who need it to pursue their studies further in the theological school, the psycho-physic laboratory, or graduate historico-philosophical or educational study. This book illustrates, in a word, not realism in any saving sense as the author claims, but ecclecticism in every respect, which makes that word philosophically offensive.

Professor Bowne's book is mainly devoted to what he holds to be the underlying principles of pure or introspective as distinct from and presupposed by all forms of empirical psychology. These principles, he thinks, are best illustrated in common facts, and that an "authology of madhouse and hospital stories" has an "odor of quackery." Though physiology "means well," and is an "estimable science," its influence in reconstructing psychology seems to the author declining. He is conscious that in his book many "will not find what they want," and "still more will find what they do not want," and many arbitrary omissions are confessed, owing to the plan of the work, but others are as free not to read as he to publish, etc. The work falls into two parts—the factors of the mental

life, and their combination. The starting point is the analysis of the individual consciousness. Psychology is a subjective and not an objective science, and is based on introspection. It is not truly studied by an analysis of language. Psychogenesis, observations of animals, etc., "admit of almost no experiment," and its "facts admit of no exact measurement." "The man who feels cold is cold," etc. All materialistic assumptions are to be "repudiated in advance." Anatomical discreetness is inconsistent with mental unity. If the brain secreted thought we could collect and look at it as we do bile. Materialism rejects the reality of the self as the subject of the mental states, which is the burden of what positive doctrine the book contains. "Thought and feelings demand a subject, and have no meaning apart from it." "Rational life, by its very nature, demands a unitary consciousness and a unitary subject." Neither the matter of the physicist, nor the thinking matter of the hylozoist, nor the theory of two parallel series, is rational. "If materialism be true reason is exploded." It is depressing, has no standard of truth, afflicts the pure psychologist with "tedious superficialities and drolleries." "What ever progress brain physiology may make it will never bring us one step nearer to materialism." It has "an irresistible tendency toward error, superstition and falsehood," and it has "falsified experience at the start," and gives a "manikin conception of humanity." The difficulty in identifying physical and mental facts lies in their complete unlikeness. Vibrations are not sensations. "No peering, even into the living brain, would give the least suspicion of the mental series attending it." Again, nerves never feel. Sensations are mental reactions against nervous actions, and are not passed along "from one atom to another, like a letter from hand to hand." A sentient nervous action is a square circle. The doctrine of the specific energy of nerves "has been largely abandoned." It is the "terminal structure" in which the specific energy resides. Thus "concerning the particular form of the nervous action nothing can be known," but "our complete ignorance of what takes place in the nerves is no psychological loss." Neither practically nor "psychologically should we be better off if we knew all about the form of the nervous action in any special experience and the place of its location." All such facts are "not properly psychological facts at all," nor even "facts of any kind" to the idealist. The psycho-physic law represents "no significant principle." A blind enthusiasm has magnified Fechner's formula into undue importance. "In the name of a mathematical formula, psychology is loaded down with meaningless absurdity." All explanations of after images are "purely hypothetical." The mixture of colors by rotating disk "does not take place in the mind but in the nerves." Such works as Helmholtz—"Sensations of Tone" and "Physiological Optics"—"reveal no new psychological principles." There are probably no unconscious sensations. Ideas have no intensity and also no attractive or repulsive forces by which they separate or unite. The studies of association-time merely show what was known before, viz.: that familiar processes are quickest. The "cerebral theory" of memory, which fills a long appendix, "has generally been regarded as demanding separate cells for the preservation of distinct experiences." Each idea, "we are told," is based on the action of a separate cell. Molasses *e. g.* has an odor, taste, a name for ear and eye is of many kinds and associated with many things, and is after all but one word,

while a man like Mezzofanti spoke fluently thirty, and knew something of seventy-two languages. Each one of all these variations demands a cell, and thus if the cerebralists were right the cells "would get filled up," and the possibilities of experience and knowledge would be exhausted. The facts of aphasia on the cerebral theory "lead to the most fantastic and grotesque assumptions and whimsies." It is all "physiological mythology born of materialism." It "necessarily increases our difficulties without adding any insight," "explains the obscure by the obscurer," abounds in "unmanageable features," is a purely gratuitous hypothesis," a piece of "physiological metaphysics," "immensely increases our difficulties without adding any insight," etc., etc.

The "thought-factor," according to Professor Bowne, works over sensation under the idea of time, space, cause, etc. Sensation is set over against the self, classified and related. If Mill's "psychic chemistry" theory of the origin of space-perception were true, it would "bring thinking to an end." The notion that sensation or that the mind is extended is also a "whimsey." If the thought of extension is extended the thought of infinite extension must require an infinitely large mind to contain it. Mill's view of the nature of the thinking self is "plain nonsense." By the theory of the "permanent possibilities of sensation" "language has been outraged," and "we are in the lowest depths of unintelligibility." "The metaphysical denial of the reality of substance leads to nonsense in the mental world and to nihilism and solipsism in the outer world." "The associative theory is one of the sorriest efforts of speculation." "Materialism cannot be joined with any sensational philosophy without mutual destruction." This alliance is "one of the many inconsistencies of evolutionary thinking." Mind-stuff and psychoplasm are "highly elegant conceptions" as "figures of speech that defy all interpretation." "Evolution has no such importance for psychology as its friends imagine." Its facts are "without theoretical significance." Herbert's deduction of feelings is "a failure in all respects." Physiological æsthetics is rejected, for a noise hurts a nerve no more than a note does. The claim that the self is made out of the sum of mental states is made up of "some extravagance, some ambiguity and considerable nonsense." Fichte's view of the rise of self-consciousness "is an abuse of language." Whether we can be conscious of more than one thing at a time is "an idle question." The view that memory "is the form of mental action most dependent on physical conditions" is "probably much exaggerated." Many facts of aphasia are "utterly opaque on any theory." The treatment of the judgment in formal logic is "entirely false to its psychological character," "highly artificial," and "often does violence to the psychological fact," "a barren study of verbal permutations." This tendency reaches its climax in the later forms of symbolic logic by becoming purely mechanical. The fourth dimension theories are like reasoning on the assumption of a square circle. The soul is in direct interaction with the brain, but need not be in it, but at an infinite distance from it, and in fact is not in space at all. The subject of localization of the functions of the brain is "in entire uncertainty." That the ground of insanity is physical "can hardly be said to be made out." Yet the soul and body are in some kind of interaction and mutual dependence. "Certain forms of memory seem even conditioned by physical participation."

Besides these salient points, the book of Prof. Bowne contains much current psychological matter and a few subtle criticisms. Though his spirit is much more narrow and provincial, the author is far better read in both the ideal and empirical literature of his topic than the writer of the book noticed above. But his work surpasses anything we have ever read in the field of modern psychology, not only in its hardihood of brunt denial of accepted facts and interpretations, which if sustained would reduce many a settled consensus back to the plane of debate, but in offensive and ill-bred language, which can only tend to lower the tone of the controversy, and which fills us all along with painful doubts whether a self-respecting reviewer ought to touch it. Students, whose knowledge of psychology was derived from this book alone, would be led to believe that all workers in a vast field of science, not only deal largely in "plain nonsense," "whimsies," that "outrage language," "are loaded with meaningless inconsistencies," if indulged in are liable to "explode reason," "bring thinking to an end," etc., but that scientific men at heart know better, and are "ever seeking to evade," "explain away," "escape" some great and obvious first truth of reason. They would think that those who seriously study the localization of functions in the brain, psycho-physics, symbolic logic, neurological physiology, comparative psychology, psycho-genesis, the two great works of Helmboltz, and all who labor in those fields ; that morbid psychology, the unconscious in all its forms, and everything that savors of matter, evolution or sensation, represent a vast incoming tide of perversity, whipped up, to be sure, by diabolic cunning into fine and insidious intellectual sillabub, which is sweet to the palate, but which it is not merely folly but morally infectious to imbibe. The resources against these new men and methods and topics are first bravado of negation. Have not several critical inventories of human powers shown that understanding can never know this, and reason can never do that? No faculty or investigator must be allowed to poach beyond the lines laid down by the great Kantean survey, even for an hypothesis or conjecture. It is the function of the philosopher to enforce the licet and non-licet of the code. Secondly, mind must be dematerialized, which now means deneuralized. To do this at every point is Professor Bowne's chief effort. Among the many phobias, or morbid fears, now quite well defined, is mysophobia, or fear of dirt, first described in 1878, which impels the patient to wash every object he must touch, and to wash the hands after dreaded contact with everything more palpable than thin air, often scores of times a day, to avoid pollution or contamination. Its analogue we may call hylephobia, or morbid fear of materialism, also a very modern distemper, which afflicts, now and then, a philosopher with a horror of contact with the fresh facts of science so necessary to his survival in the world of modern thought, and impels him to try to purge every element of matter from facts he cannot escape. Hylephobia, however, is now often regarded as a sacred madness, as epilepsy used to be. It befalls only the good ; and the richer and fairer the world of sense, and the more violent the phobia against it, the more surpassingly rich and fair and real must the purely subjective, rational, ideal world appear. All the wisdom of scientific psychology melted in this author's crucible is but slag and dross, and that of so malodorous a kind that not only is he as excusable for the oft-repeated errors and ignorance of de-

tails his pages betray as he would be for holding his nostrils in a foul air, but we suspect that this ignorance and audacious defiance of authorities is a part of the disease, and thus as sublime as the filth in which white-souled anchorites gloried. Thus it would be not only a long, but an all too-thankless, and even idle task, to point out the blunders in detail. Although students of the book would find it infectious of this mania, they would get very little knowledge of the adversary against whom they were to crusade. Indeed, they would hardly suspect even the existence of a vast and concillient body of facts concerning the validity and significance of which there is no dispute among those competent to judge, and still less would they glimpse their vast variety, their wide-reaching suggestiveness, or realize the unsurpassed mental discipline and moral vigor they afford, the quickening of all the psychological roots of the religious sentiments of reverence, subordination and hopefulness they bring. Against the old materialism of Büchner, Moleschott, Carl Vogt, or Czolbe, which is the real object of many of our authors' attacks, and of which many residua still linger, especially among young men, his weapons are occasionally effective, but the psycho-physics of to-day is far nearer the standpoint of Kant than of these writers, and admits, as fully as Professor Bowne himself, the utter incommensurability that appears between a physical solid and conscious activity. He repudiates mad-house tales, but Mr. Galton says: "No professor of metaphysics, or psychology, or religion, can claim to know the elements of what he teaches, unless he is acquainted with the ordinary phenomena of idiocy, madness and epilepsy. He must study the manifestations of disease and congenital folly, as well as those of society and high intellect." The spirit animating this volume is utterly unlike that of Lotze, whom the author followed with such fidelity in an earlier work, or that of Prof. Alexander, who admirably says: "There are two common mistakes—one, the denunciation of physiological methods by men who have never seen a ganglion cell; the other, the denunciation of subjective methods by men who have never given an hour to introspection. It does not appear to be necessary, however, that a knowledge of one set of facts should be incompatible with a knowledge of the other set. A combination of the two is the ideal psychology." We would not lay aside this almost purely negative book, which it is generally very hard to treat seriously, however, without expressing some real obligations to the author, to whose vigorous analysis we are indebted for some insight, and who has pointed out a few real defects in both the methods and inferences of modern psychology. These defects are by no means fatal, but very slight, incidental, and easily corrected. "Indeed," he says, "if our mental possession should suddenly shrink to what we know, the residue would be paltry and pitiable in the extreme. It is only by venturing beyond knowledge that a social or even mental existence becomes possible." This cheap opinion of knowledge may perhaps account for his uncermonious way of treating it, and his struggles beyond it, if it be a struggle for mental existence, every evolutionist will easily excuse. Again, he exclaims in a collapsing or despairing way, near the end of the book, "there is a great body of facts which suggest that the mental life cannot go on without the physical. Can any light be thrown on this question?" That is, indeed, the serious question, but does it not belong at the beginning of any helpful

book, devoted so largely to just this question, rather than at the end? That is, at least, precisely where the psycho-physics he so perhorresces begins, and that is just the question. Even the few isolated facts he reports, if sympathetically scrutinized, start us so hopefully, at least, towards answering.

Dr. Dewey's book is to Hegel as Prof. Bowne's is to Lotze. In each case the spirit of the masters animates the pupil, but has not gained in insight or breadth of view. Dr. Dewey is a less servile disciple of a better master, is on the whole better trained, not only in psychology, but in the general field of philosophy, and his book is pervaded by an indefinitely better spirit, and his material is wrought together with far more vigor, coherence and originality. There is no trace of cynicism or vulgarity. The author unfolds, with the most charming and unreserved frankness and enthusiasm, the scheme of absolute idealism in a simple yet comprehensive way, well calculated to impress beginners in philosophy, to whom the book is addressed, and with helpful pedagogic diversions. Psychology is the science of the "self," which has the power of recognizing itself as I, knows that it exists, or "exists for itself." This is consciousness which "can be neither defined or described." "The fact of the existence of self or of consciousness is accordingly a unique, individual fact." The content of knowledge is universal, for all could know it. Psychology is defined as "the science of the reproduction of some universal content or existence, whether of knowledge or action in the form of individual, unsharable consciousness." Thus "physiological psychology cannot aid psychology directly. The mere knowledge of all the functions of the brain and nerves does not help the science, except so far as it occasions a more penetrating, psychological analysis, and thus supplements the deficiencies of introspection." Physiological facts are "of no avail, for they tell us only about certain objective processes." "The ultimate appeal is to self-consciousness." Knowledge is thus universal, while feeling is individual, and will connects the two. These three are not faculties, but inseperable aspects of consciousness, resulting from artificial analysis, but for convenience made the basis of the three-fold division of the book, the greater part of which is given to knowledge. Here, too, lies its chief merit and originality. Sensation is "the elementary consciousness which arises from the reaction of the soul upon a nervous impulse, conducted to the brain from the affection of some sensory nerve-ending by a physical stimulus." The latter is always some form of motion. "A sensation is a consciousness; it not only exists, but it exists for the self." Yet we are told on the next page that we have no more direct knowledge of it than of an atom, and that it is not immediately present in consciousness. Sensations tell us nothing but their own existence, or how the subject is affected. Motion and sensation have nothing in common. Despite the usual dualistic "chasm," motion is merely a mental phenomenon. The nervous change is not cause, but stimulus or occasion on which the soul develops sensation. A sensation is "the transitions of the physical into the psychical." On this whole topic of sensation, it is impossible to grasp the author's meaning. Sensations are not knowledge. They are purely subjective, separate and distinct, each from each ; in short, chaotic. Knowledge consists in the processes of relating these individual feelings and discrete fragments. They

must be transformed not only into unities higher than those of time and space, objects, relations and ideals, but they must be changed into the self that knows and idealizes. To this end the mind must react upon sensuous material in attention, and retain the appercieved content in memory. Thus sense becomes significant, and its elements coherently related. Association "never leaves sensuous elements isolated." It combines air-pulses to tones, makes all colors out of the three elementary sensations, fuzes and redintegrates according to the familiar rubrics of successive, simultaneous, contiguous and similar, etc. Artists use philosophers notice, the associative tie that broadens but does not burden the mind, and controls habit. These products of synthesis may be disassociated by different influences, as interest or value is given to different elements. Sensations are thus distinguished by tone, by nearness of relation to self, morality, etc., till apperruptive organs, or "ways in which we tend to interpret sensations," are established. Disassociation thus breaks up the mechanism—bursts the bonds that would tie the mind down to objective data, allows it to play freely, according to its interests, and breaks up control by environment. Thus ideal internal ends may be pursued by attention, which is internally initiated, to the ends of the self. Attention is "that activity of the self which connects all elements presented to it into one whole, with reference to their ideal significance." On the fundamental principle that "nothing can be in consciousness which consciousness does not put there," attention, as the organ of selection, is very important. It selects only those elements which point beyond themselves. Thus only interpreted sensations, and never sensations as such, enter into our knowledge. This is idealization, for it passes beyond present existence. By attention the whole organized self is brought to bear or "read into" selected sense elements so as to give them meaning by "reading itself into them." Thus unity, idealization, meaning, distinctness arise. Attention is fundamentally a "self-developing activity." Thus with the aid of the assimulative function of retention "the world becomes objectified self, and the self subjectified world." "The world known is the externalized self; the self-existing is the known or internalized world." Leaving the *activities* of knowledge, its *stages* are studied as perception, memory, imagination, thinking and intuition respectively. *Perceiving* is "opposed to thinking," because it is objective and not subjective. Visual and tactual space are briefly considered, to show how it is the will which separates objects from itself. This is the central distinction in this field where differentiation predominates over identification. *Memory* is higher for the present is transcended. All its objects are "wholly ideal." Past and present are related or unified in rythm. Memory is possible only where there is a permanent self amid changing expressions. *Imagination* embodies ideas and is freed from the limitations of memory. It is a "universalizing activity," releasing the ideal from the petty and particular, making poetry in a sense truer than history, and implies a basal unity between man and man, and man and nature; in short, demonstrates the "universal self of humanity" in organic unity with nature. *Thinking* still further "dissolves out" the universal and ideal "to discover the meaning of facts universally." It is distinguished as (*a*) conception, which "is the apperception of the apperceptive process;" (*b*) judgment, which refers the

ideal, or universal, to the particular element; and (*c*) reasoning, which is the recognition of relations. The highest reasoning is philosophy, which is "complete science," and seeks to find a true universe. *Intuition* is immediate knowledge of the world, self and God. Every fact is seen to be related to every other, the whole is found in the part, and this completed interdependence is necessity. The world is known because we idealize it, and the self is known because it is realized. This process goes on through the self. and from this fact we gain the conception of freedom. God is the true self-related, or the organic union of the self, and the world, of the ideal and the real. The goal of all knowledge or truth is "the complete manifestation of the unifying and distinguishing activities of the intelligence," and all error or agnosticism is emphasizing one to the exclusion of the other of these processes.

Feeling is "the internal aspect of mental life," and exists so far as consciousness is unobjectified. As the latter is never complete feeling, though unique and unsharable is "as wide as the whole realm of self," and is the undividual side of its activity. If the self is furthered, pleasure; if hindered, pain results. Successful adjustment is pleasant. Feelings are sensuous and formal, qualitative, intellectual, æsthetic and personal. The last three have gradually unfolded into universality. Under personal feelings peace, dependence, faith, obligation, remorse, humility, sympathy, love, conscience, etc., are treated. Conscience, *e. g.*, is a "feeling of the universal and objective worth of personal acts, but in what degree the feelings are true to fact depend upon how universal and objective is the self which feels." Will originates in sensuous impulses. It is the self realizing itself. The essence of self is the self-determining activity of the will, which is objectifying activity. Science is the objectified will. Will finds its motive in feelin its result in knowledge. It unites the individual and the universe, joins the finite self and the infinite personality in which truth, happiness and righteousness are united in one.

Dr. Dewey's book is admirably adapted to reproduction by a resumé of salient points and ever recurrent phrases. Its merit and originality are great, but they all lie in the scheme rudely outlined above. That the absolute idealism of Hegel could be so cleverly adapted to be "read into" such a range of facts, new and old, is indeed a surprise as great as when geology and zoology are ingeniously subjected to the rubrics of the six days of creation. The older geneses, whether of the world or of mind, are so simple and ultimate, have been rounded to such epic completeness and sublimity, that as they are superseded by still larger and loftier conceptions, their dissolutive phases are often pathetic. The pathos here lies in the naive unconsciousness with which the system of universal consciousness unfolds all its vast canvas of definition on the stormiest of all seas that science tries to navigate. Definitions make the fibre of the book, and even the favorite form of sentence. The author is always working from partial to complete definitions or conversely. There are scores of formally quite novel definitions of nearly all the subject matter of psychology. They are treated as self-luminous, or, at most, their fit or self-relation is their justification, and these constitute the warp of the entire fabric. Viewed from the standpoint of facts, very few of them are satisfactory, and many we believe to be fundamentally wrong and misleading. To enter upon this, however, could only at most open perhaps long

but certainly fruitless controversy. But the author is more intent on the mutual interpretation and coherence of his network of definitions than on their relation to facts, and it is just this that makes his book as unitary as Dr. McCosh's is rambling and incoherent, as positive as Professor Bowne is negative. The "self," *e. g.*, is treated as something of settled and exact connotation, simple and undefinable and immaterial, without a hint or suspicion of the vast problems opened by both disease and by hypnotism, pointing to its derivitive, or at least exceedingly complex nature. Memory is treated only as a member of a hierarchy of faculties, and with no word to suggest that there now lies the chief field of controversy in psychology between a material and pneumatic view of soul. The whole vast field of what was at first and so crudely termed by Hartman the unconscious, and where the scientific study of psychic activities has of late won its chief triumphs, is substantially ignored, although consciousness itself, with which the author is solely concerned, we are told "can be neither defined or described." To say that an act is unconscious means simply that "the act is done by the body" as a result of simultaneous association.

Besides definitions, the other ingredient of the book is illustrative facts. In the selection and use of these, for which the writer is often indebted to the results of modern scientific methods and is duly grateful, lies the other chief merit of the book, which, however, by a man of great ability as Dr. Dewey clearly is, might have been written half a century ago, and have been poorer only by a number of pat physiological illustrations. The facts are never allowed to speak out plainly for themselves or left to silence, but are always "read into" the system which is far more important than they. They are nearer to the sphere of sensation, incohate, dark, solitary, than to the pure self-luminous light of self-consciousness, which is turned on them in these pages. In the field of these facts the statements are extremely often vague, inexact and even mistaken, and abound in the errors, often petty, sometimes grave, of non-expertness. These we can only sample. "A *wave length* of .00009 millimetre," it is said, can excite the sense of hearing. The retinal image is "interrupted by the blind spot." Flavor is said to involve tactile elements. The tone of a tuning fork is simple; "all others are complex." The whole statement of this great discovery, which Helmholtz calls "the most important of recent times," is vague and general to the verge of utter unintelligibility. Four or five times in the book we are told of the lower and upper limits of tone-perception, and the sensation above 40,000 vibrations a second is repeatedly described as "whirring," a term it hardly seems as if one who had once felt it could apply. "Whirring" is near the lower limit. "It is highly probable that the auditory nerve continues the sound stimulus in vibrating form." Heat is said to be a stimulus that "affects all sensory organs alike." Touch "is distributed by means of the skin over the whole body." Again, "the skin is regarded as made up of myriads of sensory circles." All but hot and cold spots on the skin are said to be "sensitive to no kind of temperature distinction," and cocoine anaethesia and leaves the parts affected "as sensitive to differences of heat and cold as ever." "The reason that we do not see the stars in the daytime is that they do not give $\frac{1}{100}$ of the light of the sun." The psycho-physic law unquestionably merits far fuller treatment in any psychology. Almost nothing is said of in-

stinct or of morbid or anthropological psychology. Omissions, however, may be pardoned, inaccuracies never. If we are to have facts and results of laborious scientific work, let them be stated clearly and exactly. Dr. Dewey's method is through and through speculative, and psychology in its leading features is to him one of the most complete and finished sciences, instead of being in the most interesting stage of uncertainty and incompleteness. Not only all actual but all possible future facts are certain to take their place in this idealistic scheme. They may indeed enrich it, but can never essentially change it. In the open field of research, however, it is precisely these general views that are now most uncertain and wavering. Is self-consciousness inscrutible, and ultimate, and supreme? What is it, what is the self, and what is knowledge? Is there a "chasm?" Is sensation pure and manifold, or is it the most perfect knowledge, reason being sensation in the making, as Maeh assumes? What are ideas, and can we know an "organic unity" more complete than, say, a gaglion cell? Is not such an unity rather in the nervous system than in conscious thought? What if consciousness be not only a partial and fragmentary manifestation of individual life, but, as some postulate, a form of disintegration, a set of signs of the imperfect working of our infinitely complicated automatic apparatus? None of these are open questions for Dr. Dewey. It is not enough to know even if we know truly, but we must know that we know. It is not sufficient for light to shine; it must light itself. Even "the perceived world is more than the existent world." One who philosophizes by this method might exactly as well write a text book on any science whatever as on psychology. The light is always essentially lighting itself, from whatever objects it happens to be reflected. As an artist is less interested in the subject of a picture printed on the programme, or the philologist cares less for the story of a classic writer, but both are more intent on an ulterior analysis that shall reveal the great elements of style and motive, and reach a meaning below the author's consciousness, so the modern psychologist studies the great systems of philosophic thought—this with the rest. In the system of "progressive self-realization" in the idealistic sense he sees the lift and expansion of adolescent, altruistic forces, always inspiring and ennobling, which every young man is the stronger and broader for having felt, the enthusiasm of which no student of any philosophic subject can miss without grave loss, and to the meaning of which, having felt, he will always remain pious. But it is a stage of development which minds that come to full scientific maturity are certain to transcend. Its phrases grow dim and unreal, and have a hollow, uncertain sound, in the quest of something more definite and real and systematic. Were this issue reached at the end, or tendencies to this larger view seen in the author, the propadeutic virtue of the book would be greatly enhanced. To students inclined to immerse themselves in an ideal view of the world it will prove very stimulating, but dire will be the disappointment of those who hope to find in it the methods or results of modern scientific psychology. The literary references at the end of the chapters will prove very helpful, but those of most scientific value are not much utilized in the text, and nearly all these authors would not agree with the argument, for such it is, of the work. Finally, for class-room use the book is far from satisfactory. Statistics now before us, embracing nearly three hundred colleges, are very far from sus-

taining the statement of the preface that "it is the custom of our colleges to make psychology the path by which to enter the fields of philosophy."

Elements of Physiological Psychology. A Treatise of the Activities and Nature of the Mind, from the Physical and Experimental Point of View. By George T. Ladd, Professor of Philosophy in Yale University. New York, 1887. pp. 696.

Thanks to Professor Ladd's book—it is at last possible to read a plain statement of the facts of a good part of the field of experimental psychology in English. Its merit in this fundamental respect is incomparably greater than any one book in our language, and it is likely to be for a long time indispensable to every student of the subject not familiar with German. Roughly speaking, over five of his nine hundred pages are devoted to a condensed and generally clearly arranged account of results of special scientific investigations, less concisely stated than in Hermann, but more lucid than in Wundt. The facts are often gathered with great industry from many special monographs more recent than the chief German text books, and along some lines brought down to date without substantial omissions. The author is not intent on illustrating any theory or system belonging to an utterly different attitude, period and method, or stage of development, but the system consists in a plain grouping of the facts which are allowed to speak out for themselves. Taken all in all, the book cannot fail to have a most wholesome and stimulating effect on the study of mental phenomenon in the institutions of higher education in this country. It should be read by students of medicine and theology, as well as of philosophy, and teachers who desire to know the scientific basis of modern methods of pedagogy will derive great benefit from its pages. The vast fields of morbid and also of anthropological psychology, psycho-genesis and instinct, which might be included in the title, are excluded, and even within the limits imposed on himself by the author, there are many deficiencies, but from the fact of so large a book, covering only a part of its field, the reader will readily infer the immense accumulation of material which already crowds the psycho-physic domain, and superficial or disparaging text-books in this field will henceforth be impossible, or at least ignored. All this applies to the first two parts, or to the first two-thirds of the book only. The first part is devoted to the nervous mechanism. The nervous elements are first considered chemically and histologically and physiologically, and then their combination into a system involving a sketch of the general anatomy of the cerebro-spinal system. Nerves as conductors, automatic and reflex functions and organs, the development of the nervous system and the mechanical theory of its action, are each given a chapter. Part second is on the correlations of the nervous mechanism and the mind. Two long chapters are given to localization, and two to the quality of sensations, one to their quantity; then come two chapters vaguely entitled the presentations of sense, devoted to the perception, as it is more commonly termed of space, form, motion, etc.; then come physiological time, feelings, and a final and isolated anthropological chapter on certain statistical relations of the body and mental phenomena. These chapters are illustrated by one hundred and fourteen wood cuts, about ninety of

which are anatomical, mostly gross, and copious references to special literature are given the form of foot notes, and there are many tables.

In the present condition of foreign literature, it is far easier than it would have been a few years ago, to compile a book like this; but it must still have required not only much industry, but considerable time. For one not practically familiar with laboratory methods in physiological chemistry, histology, physiology and psychology, to have done this work on the whole so creditably, even from the standpoint of specialists in these fields, suggests the possibility or a division of labor between writers of general treatises and those engaged in experimental research, which may perhaps be helpful to both, and to the cause of science. With so large a book, so filled with facts it is impossible to deal in detail. We shall content ourselves in pointing out a few of the significant defects of the book, which it is hoped may be remedied in another well-revised edition. To dissect out the axis cylinder of nerves to be chemically analyzed by itself is said to be "by no means always easy." All such preliminary anatomy is of course at present as absolutely impossible, as it is indispensable for specific results of pertinence. That this cannot be done renders much of the general chemical information presented scarcely more relative to psychology than to general biology. A compilation of the inferences now indirectly suggested in the field of micro-chemistry, by the action of different staining fluids, would have been better. Again we are told that "one of the processes of each cell may, as a rule, be regarded as continuous with the axis cylinder of a nerve fibre." This general view, which also conditions much else, is rendered improbable, if not false, by the work of both Golgi and of Forel, the total ignoring of which, as well as of so much valuable Italian work generally, is a grave defect. The treatment of cells is inadequate and apparently uninformed, and yet cytological conceptions now seem likely to be those upon which the whole mechanical theory may be reconstructed and transformed. The account of Wundt's theory of the mechanism of nerves seems derived entirely from the chapter in his psychology, which is called "more complete" than his larger work on the subject, but which is very meagre, almost to the verge of unintelligibility, as are the accounts of the theories of DuBois-Reymond and Hermann, and none of the later phases of the question are presented. The chapter on the mechanical theory is probably the most inadequate in the book. On the basis of what is given in this vast topic everyone would agree with the author's conclusion, that a "confession of ignorance might fitly close the entire discussion." In the chapter on reflexes Eckhardt's larger work, which might have been followed, if not as literally as Foster and Balfour confessedly are in the embryological chapter, at least no less implicitly than Hermann's Handbuch is in some parts of other chapters, and other well-known works elsewhere, is apparently unknown. Had it been utilized the chapter might have been materially improved, and especially the work of the Ludwig school on this important topic would have been given due place. Those whose interest in physiological psychology is rooted in metaphysics, attach great importance to studies on the localization of cerebral functions, a line of research upon which many physiologists look with suspicion as a field with which the methods of experimentation in vogue, in the

backward state of psychological analysis, are not yet able to cope in a way to give assured results. The latter are few and briefly stated, the controversies voluminous. Instead of the two long chapters devoted to this topic the utility of a book of this size would be increased by a briefer statement of the results of experiment, with reproductions of the charts of Exner and of Flechsig, which, strangely enough, with all mention of the extremely significant and perhaps epoch-making work of Steiner, are omitted. These three land-marks in this field should by all means be given a place in another edition; but all this material should be more briefly and concisely stated, and more space given to the great topic of aphasia. In such a book Jäger's theory is surely worthy a passing mention. The chapter on the quantity of sensation is hardly less inadequate than that on the mechanical theory, and needs much reconstruction. Not only are extremely significant views entirely ommitted, like that originated by Mr. C. S. Pierce, but Fechner's general conception of the subject, and Delboeuf's method and its motivation are substantially wanting, and there seems to be here, as occasionally through the book, padding with matter, the bearings of which are not fully seen, or at least not stated. The two chapters on perception will prove very convenient in the class-room. In this vast field, also, the work of a compiler must be hard, and great range for individual preference should be allowed. The work of Le Conte Stevens certainly merits mention, and the author has given too little attention to the views of Hering. There is ample field here for more cuts, even if at the expense of some of the common brain chart. The time chapter, though much less useful for students than the later conspectus of Professor James, is valuable. The work done here is limited, and admits of easy statement. Time sense and reaction-time, however, have so little to do with each other that it would have been better to separate the two and to have given the former topic a fuller treatment. The last three chapters of part second are less concise and more speculative, but still very convenient to the student for the facts they contain. As a whole, the work bears somewhat the same relation to the field it covers as President Porter's *Human Intellect* does to psychology from its standpoint. Professor Ladd's work, however, is incomparably harder and is far better done. That everything pertaining to "insanity, delerium, aphasia, somnambulism, ecstacy, mind-reading, spiritualism, and even sleep and dreaming," are "definitely excluded," because these are not normal states, illustrates the extreme superficiality of the demarcation of the field. This has, however, the great convenience, that in these excluded fields lie just the problems which at present seem most inconsistent with the author's appended theory of the reality of a thinking ego, and the final and absolute nature of self-consciousness in the sense held to by him. Over and over again we are reminded of the utter disparity between brain action and concommitant consciousness. Yet diagrams of even the gross anatomy of the nervous centres profusely given, seem to him more relevant than are the above manifestations of the unconscious to the standpoint of the "forever undefinable consciousness." Moreover, just appreciation of the facts in this excluded field is precisely what tends to break down the middle wall of partition between nervous and mental changes, every chink in which metaphysicians are so intent on stopping, and gives a sense of a correlation between them which is something more and nearer

than telepathic. The general disregard of methods of research, the description of which affords a natural, logical approach to experimental results, aids again in isolating neuro and psycho-physic facts.

The experience of a man who has once had the invaluable training of abandoning himself to long experimental research on some very special problem—whether with a nerve-muscle preparation of a frog, the structure of a ganglion cell, physiological time or any topic wisely chosen, and whether working under the guidance of a great teacher or of his own instinct, is often somewhat as follows. At first there is a sense of limitation, a fear of loss in focusing all energy upon so small and seemingly insignificant a subject. It seems not liberal, still less broad philosophic culture. Especially by those used to the unrestrained freedom and slightly enervated by the sense of "vastation" which makes metaphysical speculation so intoxicating, it is often abandoned as less attractive than the free treatment of results of others' work. If the work is pushed on, however, the student finds that he must know in a more minute and practical way than before—a way that comes to make previous knowledge in the field seem unreal—certain definite points in electricity, chemistry, mechanics, etc., and these are brought into fruitful suggestive unitary relations with each other. The history of previous views pertaining to the topic are studied and understood as never before, and broader biological relations are gradually seen. As the work goes on for months and perhaps years it gathers momentum until gradually many of the mysteries of the universe seem to him to centre in his problem. In the presence of one minute fact of nature he has passed from the attitude of Peter Bell, of whom the poet says, "a cowslip by the river's brim, a yellow cowslip, was to him, and it was nothing more," to the standpoint of the seer who plucked a flower from the crannied wall and realized that could he but understand what it was root and all, and all in all, he would "know what God and man is." Even though he may not have contributed a tiny brick to the great temple of science in the shape of discovery, he has felt the *omne tutit punctum* of nature's organic unity in a sense far deeper than speculation knows, and has realized what higher education in the modern, as distinct from the mediæval sense, is. In a word, nearly all the defects in the book before us spring from the circumstance that the facts of physiological psychology, which we are told in the Introduction cannot be called "even a definite branch of the science of psychology in general," are viewed with the eyes of Peter Bell, which seeing, see not. This appears in the frequent dependence on current hand-books, in the perspective with which certain groups of facts are presented, the purely external classification, in a few novel translations of technical terms, as *e. g.*, *Nervenstrecke*, *Zwangsbewegungen*, *Erregungsherde*, etc.

The third part need not detain us. Its merit, standpoint and style are so different that those interested in the first two parts will care little for the third, and *vice versa*. The author's creed respecting the powers and unity and development of the mind and its relations to the brain lead up to the culminating thesis of "The Mind as a Real Being," the failure of experimental studies up to date to demonstrate which occasions their repeated designation of "psychology without a soul." In the preface we are told that "one result of all our subsequent investigations will be to show us that consciousness

and its primary phenomena can never be defined." Histology gives much information, but it is "mingled with a still larger amount of conjecture and doubt." Why brain changes and conscious experience are related "will always remain an unsolvable inquiry." We are "indefinitely far" from "even a reasonable prospect" of a physical science of the nervous system. Science is "not yet able to deal with the phenomena of nervous action, as shown even by a single living nerve with a muscle attached, when acted on by any one form of external stimuli; how much less," etc. It is all "a leap in the dark;" "difficulties are absolutely insurmountable;" were brain-changes known they could not be conceived as a "true cause" of anything psychic. The mind is "a real unit being," "of non-material nature, and acts and develops according to laws of its own" and its "origin and destiny, its mortality and corruptability, physiological psychology finds itself unable to demonstrate, though it may suggest, and perhaps confirm," the author's theories in this field. It may, however, clear away "barriers of ignorance and prejudice," and open up a broader way "to rational psychology, to ethics, to metaphysics and to theology." We shall not quarrel with all this. It can be said in any field of science that there is a something quintessential not yet explored. Science is not ontology, but phenomenology, and there is nothing in physiological psychology to disprove the author's creed nor our own. As to the whole "two clock theory," it is as true in the entire psycho-physic field as Hughlings Jackson well says it is in morbid psychology, that even to understand the brain we must not take too materialistic a view of the mind. The concomitance theory is far better, even as a working hypothesis, than the theory of identity. To say, he asserts, that ideas produce movement, the mind influence the body, etc., implies disbelief in the doctrine of the conseveration of energy, and the use of all such terms as ideo-motor, physiology of mind and even psycho-physics is a logical cross division. If an histologist can use any or even all conscious activities as means to study brain structure, or if structure be studied as a means to a knowledge of function, the argument of correlation vs. ideality is as irrelevant in kind, at least, as it would be in the field of any other comparative study. That the author utilizes his "sense of chasm" by restating so well on the whole, though with such needless prolixity, these inveterate and to our thinking, mild and commonplace Lotzeanisms apart by themselves, instead of having them "read into" the experimental details like Dr. Dewey, erects to our mind another prejudice in favor of his dualistic attitude.

In the whole field of biology, including psychology, it is as often necessary (and probably increasingly more so) to proceed from the complex, whether the organic unity of the cell, the physical individual or his consciousness, to the simple, as from the simple to the complex. That any one who has carefully studied the modern concepts of physics concerning matter and force, however firmly grounded in the mechanical theory, will fail to feel that, as Mach has so fully pointed out, physics may be very soon led to a very different, psycho-sensory definition and conception of matter and force, seems to us unlikely. Striking and grateful as such a conversion would be to those whose whole psychology centres in the theory of knowledge, it would only modify the form of a single symbol, or be a light of different hue shed upon a familiar sense.

It would only aid us to see that conceptions of mind and of matter, of self-consciousness and motion, cannot possibly be disparate and incommensurable, because both are concepts, and equally ideal—that least immediately known, in fact, the most ideal. For theological minds it is consciously or unconsciously the question of immortality that animates all this kind of argument. From this standpoint nothing conld be more unwise than to give sensations and in a sense even feelings over to neurophysics as hardly less foreign to the soul as a real being, whose chief function is to unfold *knowledge* by relating these, than body. If this is all the spiritual unity, reality, etc., that remains, and if even its traits cannot be deduced in any a priori way, but must be laboriously sought from an inductive study of particulars, then both the ends striven for in the old anti-materialistic crusade have become even more barren than we thought. Feeling, sensation, the unconscious elements in which most psychic secrets are wrapped up, as well as all matter, force and mind, transcendental and real objects, creed and fact, as well as knowledge and the ego that knows,—not one or a few, but all of these, must, of course, forever be parts or aspects of that complex concept we designate as the world, and hence ideal. For every scientific object, or for every end of knowledge *per se*, if that is the highest, it does not make one hair white or black, whether we work by this hypothesis or by that of realism. The problem between the two, though one of the most seductive of all modern puzzles, is probably the most barren and incapable of solution. The main thing is that we really work on whatever theory. Let those who prefer absorption in self-consciousness really interpret the conscious ego, and be no longer to vaunt the ancient triumph, or repeat the old stages of the method. Experiment is now checked at many points till the work of subjective analysis be done over again, and better and finer. Let those that prefer literary work now take the next step and prepare manuals as full and large as Professor Ladd's on each of the special great chapters in psychology, *e. g.*, psycho-genesis, space-perception, psycho-physic law, physiological time, physiological optics, and acoustics expression, etc., on some of which themes we are glad to know comprehensive special treatises are now well under way. Experiment has already opened, and is just beginning to work one of the richest of all of scientific mines, and every writer and every explorer of subjective consciousness must now know something practically of its methods. Coöperation here already promises, not only important acquisition to the knowledge of man, but the better academic standing of the philosophic departments in our higher institutions of learning. If there is anything on which men may now differ in opinion, and yet abate not one iota of sympathy and mutual appreciation, it is on these points.

All these suggestions aside, however, we desire to recognize, in the most candid way, the great debt of gratitude which all students and teachers in this field owe to Professor Ladd. His work is sure to give a great impulse to those studies which have been sadly hindered by the want of what he here supplies. Even for the book as a whole, we have five parts of hearty commendation for every one of criticism and dissent.

Logical Machines.

In the "Voyage to Laputa" there is a description of a machine for evolving science automatically. "By this contrivance, the most ignorant person, at a reasonable charge, and with little bodily labor, might write books in philosophy, poetry, politics, laws, mathematics, and theology, without the least assistance from genius or study." The intention is to ridicule the Organon of Aristotle and the Organon of Bacon, by showing the absurdity of supposing that any "instrument" can do the work of the mind. Yet the logical machines of Jevons and Marquand are mills into which the premises are fed and which turn out the conclusions by the revolution of a crank. The numerous mathematical engines that have been found practically useful, from Webb's adder up to Babbage's analytical engine (which was designed though never constructed), are also machines that perform reasoning of no simple kind. Precisely how much of the business of thinking a machine could possibly be made to perform, and what part of it must be left for the living mind, is a question not without conceivable practical importance; the study of it can at any rate not fail to throw needed light on the nature of the reasoning process. Though the instruments of Jevons and of Marquand were designed chiefly to illustrate more elementary points, their utility lies mainly, as it seems to me, in the evidence they afford concerning this problem.

The machine of Jevons receives the premises in the form of logical equations, or identities. Only a limited number of different letters can enter into these equations—indeed, any attempt to extend the machine beyond four letters would complicate it intolerably. The machine has a keyboard, with two keys for the affirmative and the negative form of each letter to be used for the first side of the equation, and two others for the second side of the equation, making four times as many keys as letters. There is also a key for the sign of logical addition or aggregation for each side of the equation, a key for the sign of equality, and two full stop keys, the function of which need not here be explained.[1] The keys are touched successively, in the order in which the letters and signs occur in the equation. It is a curious anomaly, by the way, that an equation such as A=B, which in the system of the transitive copula would appear as two propositions, as All A is B and All B is A, must not be entered as a single equation. But although the premises outwardly appear to be put into the machine in equations, the conclusion presents no such appearance, but is given in the form adopted by Mr. Mitchell in his remarkable paper on the algebra of logic. That is to say, the conclusion appears as a description of the universe of possible objects. In fact, all that is exhibited at the end is a list of all the possible products of the four letters. For example, if we enter the two premises All D is C, or D=CD, and All C is B, or C=BC, we get the conclusion in the following shape, where letters in the same vertical column are supposed to be logically multiplied, while the different columns are added or aggregated:

A	A	A	A	a	a	a	a
B	B	B	b	B	B	B	b
C	C	c	c	C	C	c	c
D	d	d	d	D	d	d	d.

[1]Phil. Trans. for 1870.

The capital letters are affirmatives, the small letters negatives. It will be found that every column containing D contains B, so that we have the conclusion that All D is B, but to make this out by the study of the columns exhibited seems to be much more difficult than to draw the syllogistic conclusion without the aid of the machine.

Mr. Marquand's machine is a vastly more clear-headed contrivance than that of Jevons. The nature of the problem has been grasped in a more masterly manner, and the directest possible means are chosen for the solution of it. In the machines actually constructed only four letters have been used, though there would have been no inconvenience in embracing six. Instead of using the cumbrous equations of Jevons, Mr. Marquand uses Professor Mitchell's method throughout.[1] There are virtually no keys ex-

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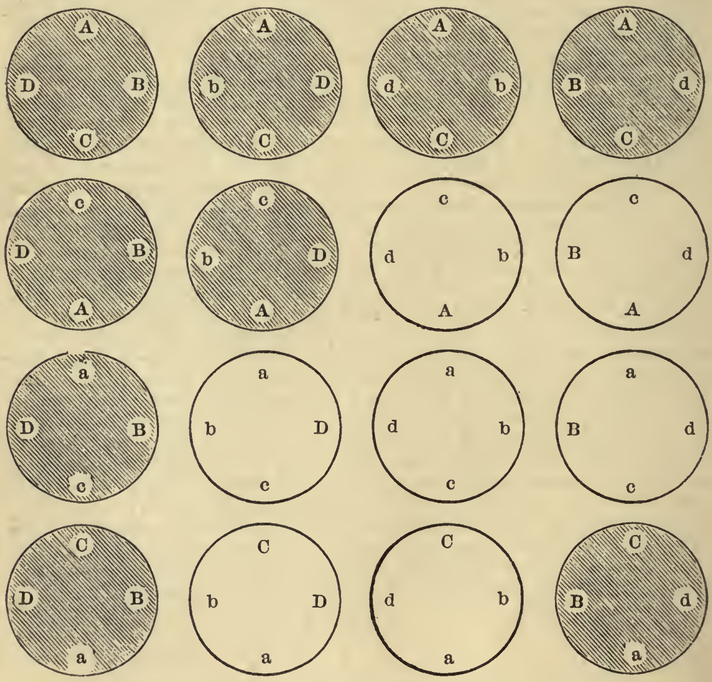
[1] It would be equally true to say that the machine is based upon Mrs. Franklin's system. The face of the machine always shows every possible combination; putting down the keys and pulling the cord only alters the appearance of some of them. For example, the following figure represents, diagrammatically, the face of such a machine with certain combinations modified:



This face may be interpreted in several different ways. First, as showing in the shaded portions—

cept the eight for the letters and their negatives, for two keys used in the process of erasing, etc., should not count. Any number of keys may be put down together, in which case the corresponding letters are added, or they may be put down successively, in which case the corresponding combinations are multiplied. There is a sort of diagram face, showing the combinations or logical products as in Jevons's machine, but with the very important difference that the two dimensions of the plane are taken advantage of to arrange the combinations in such a way that the substance of the result is instantly seen. To work a simple syllogism, two pressures of the keys only are necessary, two keys being pressed each time. A cord has also to be pulled each time so as to actualize the statement which the pressure of the keys only formulates. This is good logic: philosophers are too apt to forget this cord to be pulled, this element of brute force in existence, and thus to regard the *solvet ambulando* as illogical. To work the syllogism with Mr. Jevons's machine requires ten successive movements, owing to the relatively clumsy manner in which the problem has been conceived.

One peculiarity of both these machines is that while they perform the inference from (A+B)C to AC+BC, they will not perform the converse inference from AC+BC to (A+BC). This is curious, because the inference they refuse to perform seems to be merely syllogistic, while the one they do perform, and in fact continually insist on performing, whether it is wanted or not, is dilemmatic, and therefore essentially more complicated. But in point of fact neither of the machines really gives the conclusion of a pair of

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$$\begin{array}{llll}(A+B+C+D) & (A+b+C+D) & (A+b+C+d) & (A+B+C+d) \\ (A+B+c+D) & (A+b+c+D) & & \\ (a+B+c+D) & & & \\ (a+B+C+D) & & & (a+B+C+d),\end{array}$$

which is the same as what is seen on the unshaded portions if we regard the small letters as affirmative and the capitals as negative, and interchange addition and multiplication, that is, as—

$$\begin{array}{l} \quad aBCD+abCD \\ +ABCd+ ABCD+AbCD \\ +ABcd+ ABcD.\end{array}$$

Or, looking at the unshaded portion, we may regard it as the negative of the above, or—

$$\begin{array}{lll} & (A+b+c+d) & (A+B+c+d) \\ (a+b+c+D) & (a+b+c+d) & (a+B+c+d) \\ (a+b+C+D) & (a+b+C+d), & \end{array}$$

or, what is the same thing, as—

$$\begin{array}{ll} \quad abcd+aBcd+aBcD+abcD & \\ +abCd+aBCd & \\ +AbCd & \\ +Abcd & +AbcD.\end{array}$$

There are two other obvious interpretations. We see, then, that the machine always shows two states of the universe, one the negative of the other, and each in two conjugate forms of development. In one interpretation simultaneously impressed terms are multiplied and successively impressed combinations added, and in the other interpretation the reverse is the case.

syllogistic premises; it merely presents a list of all the possible species in the universe, and leaves us to pick out the syllogistic conclusions for ourselves. Thus, with Marquand's machine, we enter the premise All A is B in the form a+B, and the premise All B is C in the form b+C; but instead of finding the conclusion in the form a+C, it appears as—

$$\begin{aligned}&ABCD+ABCd\\ &+aBCD+aBCd+abCd+abCD\\ &\qquad\qquad\qquad +abcd+abcD.\end{aligned}$$

As we only want a description of A, we multiply by that letter, and so reduce the conclusion to ABCD+ABCd, but there is no elimination of the B nor of the D. We do not even get the full conclusion in the form ab+BC, although it is one of the advantages of Marquand's machine that it does give the conclusion, not only in the form just cited, but also, simultaneously, as

$$\begin{aligned}&(a+B+c+d)\ (a+B+c+D)\\ &(a+B+C+d)\ (a+B+C+D)\ (a+b+C+D)\ (a+b+C+d)\\ &\qquad\qquad\qquad\qquad\qquad (A+b+C+D)\ (A+b+C+d).\end{aligned}$$

The secret of all reasoning machines is after all very simple. It is that whatever relation among the objects reasoned about is destined to be the hinge of a ratiocination, that same general relation must be capable of being introduced between certain parts of the machine. For example, if we want to make a machine which shall be capable of reasoning in the syllogism

If A then B,
If B then C,
Therefore, if A then C,

we have only to have a connection which can be introduced at will, such that when one event A occurs in the machine, another event B must also occur. This connection being introduced between A and B, and also between B and C, it is necessarily virtually introduced between A and C. This is the same principle which lies at the foundation of every logical algebra; only in the algebra, instead of depending directly on the laws of nature, we establish conventional rules for the relations used. When we perform a reasoning in our unaided minds we do substantially the same thing, that is to say, we construct an image in our fancy under certain general conditions, and observe the result. In this point of view, too, every machine is a reasoning machine, in so much as there are certain relations between its parts, which relations involve other relations that were not expressly intended. A piece of apparatus for performing a physical or chemical experiment is also a reasoning machine, with this difference, that it does not depend on the laws of the human mind, but on the objective reason embodied in the laws of nature. Accordingly, it is no figure of speech to say that the alembics and cucurbits of the chemist are instruments of thought, or logical machines.

Every reasoning machine, that is to say, every machine, has two inherent impotencies. In the first place, it is destitute of all originality, of all initiative. It cannot find its own problems; it cannot feed itself. It cannot direct itself between different possible procedures. For example, the simplest proposition of projective geometry, about the ten straight lines in a plane, is proved by

von Staudt from a few premises and by reasoning of extreme simplicity, but so complicated is the mode of compounding these premises and forms of inference, that there are no less than 70 or 80 steps in the demonstration. How could we make a machine which would automatically thread its way through such a labyrinth as that? And even if we did succeed in doing so, it would still remain true that the machine would be utterly devoid of original initiative, and would only do the special kind of thing it had been calculated to do. This, however, is no defect in a machine; we do not want it to do its own business, but ours. The difficulty with the balloon, for instance, is that it has too much initiative, that it is not mechanical enough. We no more want an original machine, than a house-builder would want an original journeyman, or an American board of college trustees would hire an original professor. If, however, we will not surrender to the machine, the whole business of initiative is still thrown upon the mind; and this is the principal labor.

In the second place, the capacity of a machine has absolute limitations; it has been contrived to do a certain thing, and it can do nothing else. For instance, the logical machines that have thus far been devised can deal with but a limited number of different letters. The unaided mind is also limited in this as in other respects; but the mind working with a pencil and plenty of paper has no such limitation. It presses on and on, and whatever limits can be assigned to its capacity to-day, may be over-stepped to-morrow. This is what makes algebra the best of all instruments of thought; nothing is too complicated for it. And this great power it owes, above all, to one kind of symbol, the importance of which is frequently entirely overlooked—I mean the parenthesis. We can, of course, dispense with parentheses as such. Instead of $(a+b)\,c=d$, we can write $a+b=t$ and $t\,c=d$. The letter t is here a transmogrified parenthesis. We see that the power of adding proposition to proposition is in some sort equivalent to the use of a parenthesis.

Mr. Marquand's machines, even with only four letters, facilitate the treatment of problems in more letters, while still leaving considerable for the mind to do unaided. It is very desirable a machine on the same principle should be constructed with six letters. It would be a little more elegant, perhaps, instead of two keys to each letter, to have a handle which should stand up when the letter was not used, and be turned to the right or left, according as the letter was to be used, positively or negatively. An obvious extension of the principle of the machine would also render it possible to perform elimination. Thus, if six letters, A, B, C, D, E, F, were used, there could be an additional face which should simply take no notice of F, a third which should take no notice of F or E, a fourth which should take no notice of F, E or D; and these would suffice. With such a machine to represent AB+CD, we should proceed as follows: Put down handle E to the left. [The left hand would naturally signify the negative.] Leaving it down, put down handle A to the right and then bring it back after pulling the cord. Put down handle B to the right and pull the cord, and then restore handles B and E to the vertical. Next, put down handle F to the left and successively put down the handles C and D to the right, as before. After restoring these to the vertical, put down handles E and F to the right, and pull the cord. Then we should see on the third face

(A+B+C+D) (A+b+C+D) (A+b+C+ d) (A+B+C+ d)
(A+B+c+D) (A+b+c+D)
(a+B+c+D)
(a+B+C+D) (a+B+C+ d)

or, what comes to the same thing,

aBCD+abCD
ABCd+ABCD+AbCD
ABcd+ABcD

I do not think there would be any great difficulty in constructing a machine which should work the logic of relations with a large number of terms. But owing to the great variety of ways in which the same premises can be combined to produce different conclusions in that branch of logic, the machine, in its first state of development, would be no more mechanical than a hand-loom for weaving in many colors with many shuttles. The study of how to pass from such a machine as that to one corresponding to a Jacquard loom, would be likely to do very much for the improvement of logic.

C. S. PEIRCE.

The Functions of the Brain. By DAVID FERRIER, M. D., LL.D., F. R. S. Second Edition. G. P. Putnam's Sons. New York, 1886. Pp. xxiii., 498.

Die Functions-Localization auf der Groshirnrinde. Von L. Luciani und G. Seppilli. Deutsche Ausgabe von Dr. M. O. Fraenkel. Leipzig, 1886. Pp. vii., 414.

When the first edition of Ferrier's work appeared in 1876 it attracted the attention of English readers to the subject of the localization of brain functions, and made an important addition to the mass of facts which had already begun to accumulate upon that subject. Fritzsch and Hitzig had determined in 1870 the existence of a definite area on the surface of the brains of vertebrates, irritation of which produced movements of the limbs, and destruction of which caused paralysis. Ferrier not only confirmed the results of the German physiologists, but went a step farther and succeeded in demonstrating the existence of various sensory areas in the brain, destruction of which produced a loss of some one of the powers of conscious perception. It was very natural that results of such physiological importance should be tested carefully, and there is probably no field of inquiry in which during the past ten years more active work has been done and more acrimonious controversy has arisen. Hardly any two investigators can be found who agree as to the extent of the various sensory areas, and the most different opinions as to the interpretation of the results of experiment have been defended. Ferrier's second edition is issued partly in order to offer new facts from new experiments and to modify former opinions in light of these new facts, partly in order to reply to criticism, and partly in order to defend his own interpretation of his facts. The work is almost wholly rewritten, and differs in so many respects from the first edition that it requires notice.

The work of Luciani and Seppilli received the Fossati prize of the Institute of Science of Lombardy, and was considered worthy of immediate translation into German, not only because of the new discoveries and new views contained in it, but also because of the

singularly unprejudiced and impartial views presented of the entire controversy. And this latter characteristic deserves to be commended, for much that is valuable in the writings of Ferrier, Goltz, Munk, and others, who have taken an active part in the discussion regarding the localization of functions, is obscured by the intensity of personal criticism and recrimination with which it is loaded down. The Italian authors, though holding very definite positions of their own, have succeeded in stating the views of opponents with fairness, and have suggested many probable interpretations of seemingly contradictory facts which may reconcile the inconsistent statements. They have added to the value of their work by appending to it a collection of cases of brain disease in man, which enables them to compare the results of physiological experiment with those of pathological observation.

In spite of the criticism of Goltz it must be admitted that the theory of localization has gained almost universal acceptance. Various areas of cortex of the brain are now admitted to preside over and to be necessary to various forms of mental activity. Certain parts of the cerebral cortex receive impulses from the sensory organs and preserve them as memories. Other parts send out voluntary impulses to the motor apparatus. The motor areas are definitely known and accepted. The controversy now among physiologists is regarding the exact limits of the different sensory areas. Ferrier lays down these areas in his diagrams as little circles, each separate from every other; and this extreme position must be admitted to be a logical consequence of the admission that localization is possible. Munk extends his areas somewhat more widely, does not limit them so exactly, and yet does not allow one area to invade the domain of the next. He goes even further than Ferrier in locating the visual sense, making different parts of the accepted cortex correspond to different parts of the retina. Luciani holds that each sensory area is extensive, and that, at its borders, it not only is not sharply marked off from, but really overlaps that of adjacent areas. Goltz admits that there is a functional difference between the anterior half and the posterior half of the brain, but will not allow that any distinct sensory or motor area can be outlined, claiming that the assertion of Flourens was correct and that the brain acts as a whole.

A distinction has been proposed by Exner which should be mentioned here. Exner believes that it is necessary to admit the existence of both absolute and relative functional areas. An absolute area is one, injury to which is always followed by loss of the function. A relative area is one, injury to which is sometimes but not always followed by a loss of the function. For each sense there is an absolute area, which is surrounded by an extensive relative area, and the relative areas for different senses may to some extent coincide. This distinction is virtually admitted by Luciani, whose experiments prove that loss of function is permanent when the absolute areas are destroyed, but may be temporary when the relative areas only are affected. It is not admitted by Ferrier, yet his own account of his experiments may be cited in favor of such a view, for he admits that in some of his experiments the function returned after the supposed centre was destroyed. (See p. 22 *et seq.*, where it is stated that destruction of the angular gyrus produces only transient loss of vision in the opposite eye, while if the destruction also involves the occipital lobe there is also permanent hemiopia).

It is not admitted by Munk, and yet his distinction in the case of disturbances of sight, between psychical and cortical blindness, might easily be referred to such a simple explanation. To an independent inquirer there seems to be much in favor of the position of Luciana and Exner, as it appears to reconcile in some degree the conflicting statements.

Any one who reads these statements carefully, and who also reads the detailed account of the experiments upon which they are based, must be impressed at once with the fact that the differences are due rather more to the interpretation of the experiments than to their actual results. It is a very difficult matter to ascertain just what functions are wanting, or to what degree any one function is impaired in an animal after an operation on the brain. The result which the observer looks for is the one most likely to be found, and as an animal cannot communicate its own sensations in language, much is left to be guessed at. It is for this reason that experimentation in animals seems to be of much less importance in deciding upon the location of sensory areas than the results of pathological observation in man. Munk, Exner, and Luciani appeal to pathology frequently and claim that it supports their various positions. Ferrier seems less inclined to admit this kind of evidence (p. 270), possibly because it fails to support some of the positions which he holds as opposed to other observers—*e. g.*, as to the location of the tactile centres and the visual centre. Yet it might be supposed that the English physiologist would insist upon this class of evidence, for he has directed a number of operations upon the human brain in cases of paralysis recently performed in London by Victor Horseley. Such cerebral operations are the practical outcome of the doctrine of localization, and have been its most brilliant confirmation. For the situation of the motor areas of the brain being agreed upon by all experimenters, it has been possible in cases of paralysis from brain tumor or abscess to trephine the skull and remove the disease from the brain, with the result of saving the life, and in some cases of restoring partially or wholly the function of the paralyzed limb. There is therefore a practical importance in determining the location of the sensory areas of the brain, in order that such operations may be performed when some one sense is lost as well as when some one limb is powerless. The importance of observations as to the effect of disease on the human brain, and the necessity of accurate localization of such disease after death, has not been exaggerated, and considerable effort is being made on all sides to collect and compare cases of such a kind. A definite settlement of the controversy does not seem to be far distant, for in respect to the function of sight authorities are now well agreed, the visual area of the human brain being undoubtedly in the occipital region.[1] We may hope for equally positive results regarding other areas.

The work of physiologists upon the cortex has brought to light the importance of distinguishing reflex and automatic activity from conscious volitional motion ; and the subcortical perception of sensations, which always results in an automatic response, from the cortical perception of sensations, which is always conscious, and which may or may not give rise to action. And among the most interesting results is the determination of the facts that conscious mental-action perception, together with memory and volition, are

[1] E. C. Seguin, Jour. of Nerv. and Ment. Dis., Jan., 1886.

functions of the cortex alone; also, that the association of ideas is secured by the intimate union of various areas of the cortex, through the medium of nerve fibres passing just beneath the surface.

In view of the remarkable work which is being done at present in the department of psycho-physics in measuring the time of such processes of association, the study of the physical basis of the physiological process gains in interest.

The physiologists have succeeded in demonstrating the complex organic basis of memory by these experiments upon the cortex. It is now evident that we must speak rather of memories than of memory—each sensory or motor act leaving behind it a molecular change in the cortex which is to be regarded as the physical substratum necessary to recollection or reproduction. And as the memory of any single object is made up of a number of revived impressions, each derived through a separate sense, and each received in a different area, the mental image of the object involves the activity of various parts of the cortex, the revival of numerous, distinct memory-pictures, joined in a complex unit. It follows that a single set of memories may be lost by disease in one part of the brain, while other memories remain, a conclusion which is amply illustrated in the phenomena of aphasia. (Ferrier, pp. 440–460).

That there is any necessity for postulating "ideational centres" distinct from the correlated sensory and motor centres, is combatted by Ferrier. "We have in the sensory and motor centres of the cortex the substrata of the respective forms of sensory perception and ideation, and of the individual acts of volition, simple and compound, as well as of the feelings associated with their activity. It seems more reasonable to suppose that there may be higher and lower degrees of complexity or evolution in the same centres than to assume the separate existence of more highly evolved centres for which no evidence is obtained by the results of experimental research." (Page 460.) "Intelligence and will have no local habitation distinct from the sensory and motor substrata of the cortex generally. There are centres for special forms of sensation and ideation, and centres for special motor activities and requisitions, in response to and as association with the activity of sensory centres; and these, in their respective cohesions, actions and interactions, form the substrata of mental operations in all their aspects and all their range." (Page 467.)

The discussion of the psychological side of brain action is more intelligent and philosophical in the English than in the Italian work. But both of these books may be recommended for careful perusal to anyone who desires to become familiar with the facts upon which the theory of the localization of brain functions is based.

M. Allen Starr.

Francis Galton on the Persistency of Type.

In his opening address as President of the Anthropological section of the British Association, at its Aberdeen meeting, Francis Galton gave an account of his researchesregarding the inheritance of size in seed and of stature in man, as well as certain generalizations which he deduces from his observations. His observations

have been warmly and justly welcomed by all students of inheritance, as valuable contributions to our positive knowledge of a subject where the attainment of positive knowledge is peculiarly difficult; but it seems to me that, although the general conclusions are worded with the greatest care, they are in some respects misleading, and opposed to our general knowledge of the subject.

A few extracts will serve to exhibit the results of his observations and the character of his general deductions. He says (Nature, Sept. 4, 1885): "It is some years since I made an extensive series of experiments in the produce of seeds of different sizes, but of the same species. * * * It appears from these experiments that the offspring did *not* tend to resemble their parent seeds in size, but to be always more mediocre than they; to be smaller than they if the parents were large; to be larger than the parents if the parents were very small," and that the analysis of the family records of the heights of 205 human parents and 930 children fully confirms and goes far beyond the conclusions he obtained from seeds, as it gives with great precision and unexpected coherence the numerical value of the regression towards mediocrity. He points out that this regression is a necessary result of the fact that "the child inherits partly from his parents, partly from his ancestors. Speaking generally, the further his genealogy goes back, the more numerous and varied will his ancestors become, until they cease to differ from any equally numerous sample taken at haphazard from the race at large. Their mean stature will then be the same as that of the race; in other words, it will be mediocre." He illustrates this by comparing the result of the combination in the child of the mean stature of the race with the peculiarities of its parents, to the result of pouring a uniform proportion of pure water into a vessel of wine. It dilutes the wine to a certain fraction of its original alcoholic strength, whatever that strength may have been.

He then goes on to conclude that the law of regression to the type of the race "tells heavily against the full hereditary transmission of any rare and valuable gift, as only a few of many children would resemble their parents. The more exceptional the gift, the more exceptional will be the good fortune of a parent who has a son who equals, and still more if he has a son who surpasses him." The law is even-handed; it levies the same heavy succession tax on the transmission of badness as well as goodness. If it discourages the extravagant expectations of gifted parents that their children will inherit all their powers, it no less discountenances extravagant fears that they will inherit all their weaknesses and diseases." * * * "Let it not be supposed for a moment that" the "figures invalidate the general doctrine that the children of a gifted pair are much more likely to be gifted than the children of a mediocre pair; what it asserts is that the ablest children of one gifted pair is not likely to be as gifted as the ablest of all the children of many mediocre pairs."

My first criticism of Galton's data as a basis for generalization is that they are misleading in so far as they fail to discriminate between the persistency of hereditary and that of non-hereditary parental peculiarities.

The departure of a human being from the normal stature of the race may be an example of any one of three classes of phenomena:

1. It may be physiological, or due to influences which during the life of the individual tend to dwarf or to develop it. The short

stature of sailors is usually attributed to this cause, and it is possible that the size of the seeds and the stature of some of the human parents was physiological. In this case there is no reason to expect any tendency towards perpetuation.

2. A variation may be congenital but not hereditary, as when a single giant or dwarf is born in a family where the ancestors and descendants have the normal stature.

3. The peculiarity may be congenital and hereditary, as it is when a certain stature is characteristic of the brothers, sisters, and colateral relatives of a parent; when it is a family characteristic, or when it is characteristic of a variety of the human race, like the Bushmen.

There is ample evidence that the persistency, in the descendants, of a parental peculiarity varies greatly according as it belongs to one or the other of these classes, and we know that, quite independently of any selection, a hereditary peculiarity—that is, one which is shared by all the members of a family—often shows an astonishing tendency to persist in later generations, quite independently of the time during which it has already persisted.

A most remarkable illustration may be found on page 30 of Professor Bell's memoir on "The Formation of a Deaf Variety of the Human Race." (Mem. Nat. Acad. of Sc., Nov., 1883).

In the H. family, of Kentucky, two brothers and a sister inherited from their parents a common predisposition towards deafness, as is shown by the fact that they all became the ancestors of congenital deaf mutes, although only one of them was deaf. We have no information regarding the first generation, the parents, but in the second generation one of the three children was deaf. In the third generation all the descendants, eleven in number, were deaf. In the fourth generation the record is incomplete, but all the children which are known, six in number, were deaf. In the fifth generation selection was introduced, as three of the children married deaf mutes. The records are very incomplete, but of the six descendants known one was deaf.

The genealogy of this family is given in the following table, which serves to show that, in case of a hereditary peculiarity, the tendency of the children to resemble their parents may be vastly greater than their tendency to revert to the normal type of the race.

First generation.	No information concerning their hearing.				
Second generation.	Son deaf.	Daughter hearing.	Daughter hearing.		
Third generation.	Seven deaf children.	Two deaf children.	Two deaf sons.		
Fourth generation.	No information concerning the descendants.	One child had two deaf children; no information concerning the other.	One son did not marry; the other had two deaf daughters, $D,^1$ $D,^2$ and one deaf son, S.		
			D^1 married a deaf man.	D^2 married a deaf man.	S married a deaf woman.
Fifth generation.	No information.	No information.	One deaf son.	No children.	Five hearing children.

I find among some notes which Professor Bell has kindly placed in my hands another interesting case. O. H. was the only deaf child in a family of eleven children. He had four children, two of them deaf, and three grandchildren, two of them deaf, so that the relative predisposition of his parents, himself and his children to transmit deafness may be represented by three fractions, $\frac{1}{11}$, $\frac{1}{2}$, $\frac{2}{3}$.

It is only in a figurative sense that we can say that a child is the offspring of remote ancestors as distinguished from its parents; for even if we believe in the continuity of germinal protoplasm, it still remains true that all the matter in the fertilized egg comes from the parents, and the history of the Kentucky family shows that a hereditary variation, even when it is not very ancient, may be much more potent than all the influence which comes from ancestry.

These facts, and many more which might be quoted from our stock of information regarding domesticated animals and plants, show that if Galton had studied the persistency of *hereditary* peculiarities of stature, independently of selection, his results might have been quite different, and the experience of all breeders shows that if he had tabulated by themselves the cases where the parents had the *same* hereditary peculiarity of stature, where selection had been exercised, his general conclusion would be quite inapplicable to the result.

A few months after Galton's paper was printed another paper appeared by a well-known authority (Die Bedeutung der sexuellen Fortpflanzung für die Selections-Theorie, Weismann, Jan., 1886), and on page 40 I find the statement that "when the same part is greatly developed in both parents, the experience of breeders shows that it is still more developed in the children."

It is undoubtedly true that the average child is less aberrant than the parents, and that each child inherits a tendency to revert, or, as Galton shows, to lie midway between its parents and the type of the race; but it is also true that when both parents have the same peculiarity there is a very considerable probability that some children will equal or surpass them, so that the peculiarity may be rapidly culminated by selection.

Galton overlooks the fact that the "type" itself is not a fixed quantity, since it admits of rapid modification by the continual selection of such slight variations as constantly present themselves under the ordinary and normal conditions of life.

It seems to me that the following observations disprove his statement that "the appearance of a new type is due to causes beyond our reach," as they show that the type, that is, "*the ideal form towards which the children of those who deviate from it tend to regress*" (*Galton*) may itself be rapidly modified by selection.

The observations are given by Fritz Müller in a recent number of Kosmos (Ein Zuchtungsgesuch an Mais, Kosmos, 1886, 2, 1, p. 22).

Yellow corn is very variable in many respects. The number of rows of kernels on the cob is usually from 8 to 16, cobs with 10 or 12 rows being the most common, while one with 18 or 20 rows is very seldom found. A search through several hundred cobs gave him one with 18 rows, but none with more.

In 1867 he sowed at different times, and in such a way as to prevent crossing, (1) the seed from the cob with 18 rows, (2) the seed from the finest 16 rowed ears, and (3) the seed from the finest 14 rowed ears. In 1868 he sowed (1) seed from a 16 rowed ear

which had grown from seed from a 16 rowed ear, (2) seed from an 18 rowed ear from 16 rowed seed, and (3) seed from an 18 rowed ear from 18 rowed seed.

In 1869 he sowed (1) seed from an 18 rowed ear with 18 rowed parents and grandparents, (2) seed from a 20 rowed ear with 18 rowed parents and grandparents, and (3) seed from a 22 rowed ear from seed from an 18 rowed ear, produced from seed from a 16 rowed ear. The results are given in the accompanying table:

	1867.			1868.			1869.		
Number of rows on cob from which *seed* was taken....	14	16	18	16 16	16 18	18 18	18 18 18	18 18 20	16 18 22
No. of cobs produced..	658	385	205	1789	262	460	2486	740	373
	%	%	%	%	%	%	%	%	%
8-rowed cobs..........	.3	......	.5	.1	......	......	......	......	......
10 "	14.4	3.	1.	1.4	.8	.2	.1	......	......
12 "	48.0	22.8	13.	22.6	14.5	7.8	6.1	6.1	2.7
14 "	35.6	48.6	37.8	48.5	46.7	35 4	37.3	28.5	25.3
16 "	3.2	18.7	34.5	22.2	23.7	33.8	33.5	41.6	41.8
18 "	.5	6.8	12.6	4.9	12.3	18.2	18.6	20.2	24.1
20 "	......	.1	.3	.3	1.2	4.4	3.9	2.8	4.8
22 "	......	......	.3	......	.8	.2	.5	.8	1.
26 "	......	......	......	......	......	......	......	......	.5
Average	12.61	14.08	14.9	14.15	14.39	15.52	15.57	15.76	16.15

It will be seen from this table that the number of ears with few rows decreases very rapidly in children produced from seed taken from ears with many rows, and that the greater the number of rows on the ear from which seed is taken, the smaller is the number of ears produced with a small number of rows. It is also plain that as the number of rows on the ear from which seed was taken increases, the number of ears produced with a large number of rows increases, and that we have in each case a very considerable number of ears which equal their parents and a few which excel them, even when the parent seeds are far beyond the maximum of all ordinary corn.

Fritz Müller says that he has never, except in three instances, found an ear with more than 18 rows, and Darwin in his "Variation" puts the maximum at 20 rows, yet we have in the children of seed from a 22 rowed ear no less than 4.8 per cent., or no less than 18 ears out of 373 with 20 rows, and one ear out of 373 with 26 rows. I am quite unable to reconcile this result with Galton's statement "that the ablest children of one gifted pair are not likely to be as gifted as the ablest of all the children of many mediocre pairs." It is undoubtedly true that if Müller had planted in 1869 all the seed from the 2,511 ears which he raised in 1868, instead of planting seed from only three ears, the chance of finding among the descendants ears with 26 or more rows would have been somewhat increased. In this case, however, the parents would not have been mediocre, for nearly all of them were above, and many of them far above, the average for the race, and the chance of finding in ordinary corn an ear with 26 rows is so small that it may be treated as zero.

The results also seem strongly opposed to Galtin's statement that his law tells heavily against the full hereditary transmission of any

rare and valuable gifts, for an examination of the table will show that the number of children which resemble their parents increases in this case with each successive generation. Thus the seed planted in 1867 from an ear with 18 rows produced 12.6 per cent. of 18 rowed children. The 18 rowed ear planted in 1868 from an 18 rowed parent cob produced 18.2 per cent. of 18 rowed children, and the 18 rowed seed planted in 1869 from 18 rowed parents and grandparents produced 18.6 per cent of 18 rowed children. The series is 12.6 per cent., 18.2 per cent., 18.6 per cent.

A percentage of 18 gifted children to the hundred may be discouraging to the "extravagant expectations of gifted parents that their children will inherit all their powers," but it is a most potent factor in the process of race modification by selection.

Müller's table shows, like Galton's observations, that the greatest number of children are not like the parents, but intermediate between them and the "type" or the average for the race. This is exhibited in the following table, in which the number of ears in the parent cob is given in the left-hand column, and the percentage of ears with the same number of rows, produced by the children in the second column, and the percentage of ears produced with the dominant number of rows in the third column.

1867	14	14 rows 35.6 %	12 rows 48 %
1867	16	16 " 18.7 %	14 " 48.6 %
1868	16	16 " 22.2 %	14 " 48.5 %
1867	18	18 " 12.6 %	14 " 37.8 %
1868	18	18 " 18.2 %	14 " 35 4 %
1869	18	18 " 18.6 %	14 " 37.3 %
1869	20	20 " 2.8 %	16 " 41.6 %
1869	22	22 " 1. %	16 " 41.8 %

It is thus seen that, like stature, the number of rows tends to revert to the type, but then it will also be seen that, in only three generations, the type itself may be so greatly modified by selection, that the minimum of the third generation may be equal to the mean of the first generation, and the mean of the third generation, 16 rows, is in this case very near the maximum for accidental ears.

W. K. Brooks.

E'tudes experimentales sur les illusions statiques et dynamiques de direction pour serir a determiner les fonctions des canaux demi-circulaires. Par Yves Delage. Archives d' Zool. Exper. No. 4, 1886. pp. 535–624, (with index.)

Since the days of Flourens there have appeared few more valuable contributions to the physiology of the sense of equilibrium and of the semi-circular canals than this work of Professor Delage. The author goes far toward reconciling the conflicting opinions of those who, on the one hand, hold that the semi-circular canals are special spatial sense-organs, on whose activity depends every sense of position or direction of movement of the body; and of those who, on the other hand, think there is no good evidence of a normal relation between these organs and the sense of equilibrium. The general question is this: When the eyes are closed, through what sense or senses do we derive ideas of the direction of objects in

space, and of the position of our bodies with reference to them both while we are at rest and in motion? Since any sense-organ, when placed under abnormal conditions, may give rise to illusions dependent on such organ alone, a study of sensory illusions is a valuable aid in determining through what physiological channel any particular information is usually received. When visual sensations are excluded we still have distinct ideas of the direction of the various objects about us while our bodies are at rest, and of motion and direction of motion when our bodies are moved. The subject may, therefore, be conveniently divided into a study of *static* and *dynamic* sensations and illusions.

When the body is at rest and the eyes are closed what is the sense which gives us a knowledge of the direction of things in space? An observer standing upright, with eyelids closed and his visual axis directed straight forwards, can indicate without error the direction of any object in space and the position of the various parts of his own body. But if the head be turned as far as possible about one of its axes, the judgments of direction become false, and the observer points out directions as if external space had revolved through an angle of some fifteen degrees about the head in its normal position, and in the same plane, but in a direction opposite to that of the true motion. This indicates that the organ for which we depend for static sense of direction lies in the head. Is this organ the internal ear? If the observer turns his eyes alone, while the head remains at rest, illusion is the same as before; if the head is turned, while the eyes are forced to retain their original resting position, the illusion disappears. It can be shown that the illusion has its origin in the fact that when both head and eyes are turned the eyes unconsciously move through a greater angle than the head, which is equivalent to a positive rotation of the eyes within the unmoved head, and as this contraction of the eye-muscles gives rise to an unconscious sensation, it appears as if external space had rotated through an equal angle and in an opposite direction. It is concluded, therefore, that static sensations of direction comes as through the eye-muscle and not through the semi-circular canals.

Through what means do we gain a knowledge of the position of our bodies? If an observer, with eyes closed and the head in a normal position, is supported with his back upon a board which can be revolved about a horizontal axis, as the head end of the board is inclined toward the horizon, the observer rightly estimates his position when the inclination is about 60°; at angles of less value he judges his inclination to be slightly less than the reality, but after passing that angle the error rapidly increases in the other direction, so that when the board is inclined at an angle of 120°, the body seems to be vertical, with head downward. These results contradict those of Mach, whose experiments were performed in essentially the same manner. Sensations derived from the eye-muscles would tend to correct rather than increase this illusion of position, and sensations from the internal ear have no share in it, for the illusion can only be modified by altering the muscular and cutaneous sensations involved in the change of position.

It is concluded that our knowledge of the position of the body under these conditions depends upon muscular and cutaneous sensations, together with that general sensibility which appreciates the direction of gravitation of the fluids and internal organs of the body.

Dynamic sensations may be divided into those produced by rotation of the body and by simple translation in a straight line. We are very sensitive to movements of rotation imparted to our bodies. Our author, like previous observers, has found that when the motions are of short duration we can judge not only angular accelerations, but angular velocities, and the value of the angles traversed. It is only after prolonged rotation, a condition not experienced in ordinary life, that uniform motion is attended by failure of sensation with feeling of motion in the opposite direction after arrest. But even during continuous rotation, according to Delage, we are conscious of variations of velocity, and not, as held by Mach, of changes of acceleration alone. The movements of rotation were performed, with visual sensation excluded, round each of the three principal axis of the body. In turning round the vertical axis the observer was inclosed in a box to which air but no light was admitted, and which was suspended by two ropes, the twisting and untwisting of which gave any desired velocity of rotation. In movements round the other axes the observer was supported upon revolving table, which could be inclined at any desired angle. If, during a movement of rotation, the position of the head be changed with reference to the body, the axis of rotation itself appears to be changed in the same plane as the head, and with an equal angle, but in the opposite direction. We attribute to our body such a motion as it would have were it prolonged in its natural relation from the head in its new position. It seems clear from these facts that the organ which gives us sensations of rotation resides in the head. This organ cannot be the eye, for it was found that the ocular sensations produced by rotation are less powerful than those really experienced, and of the opposite sign. The semi-circular canals of the internal ear, from their anatomical structure and by the motor results following injury of them, seem to be the organs on which these sensations of rotation depend, and the current explanation of their operation through the excitement of their auditory nerve filaments, due to variation of endolymph pressure as the head is turned round its different axes is probably the correct one.

The sensations produced, with eyes closed, by translation of the body in a straight line, are much less delicate than those aroused by rotation. When the movement is of short duration, a fairly correct judgment is formed of its velocity, amplitude and duration. When long continued, the sense of motion fails. Sudden arrest of the motion does not give a sensation of translation in the opposite direction There is no illusion as to the direction of motion when the position of the head alone is changed; therefore, the origin of the sensation is not in this part. The sensations of translation seem to have a general source, and depend upon the varied pressure of the internal organs and of the fluids throughout the body.

In brief, it may be said that M. Delage admits that the sense of equilibrium is supplied by sensations having several different sources. Besides the purely visual sensations, we depend for our knowledge of direction, either static or dynamic, upon feelings derived from the ocular muscles; upon sensations of touch, and upon general muscular sensibility; upon a feeling of the direction of pressure of the general fluids and of the internal organs of the body, as well as upon a special function of the semi-circular canals of the internal ear. The semi-circular canals are stimulated chiefly,

or only, by rotatory movements of the head, and seem to be special sense-organs for this kind of motion alone. Our appreciation of such motions is extremely delicate, as, indeed, should be expected when it is considered that it is upon movement of the head about one of its axes that we depend in every-day life for our judgments concerning our motions, and our change of position with reference to surrounding objects.

HENRY SEWALL.

Das Körperliche Gefühl. Ein Beitrag zur Entwickelungsgeschichte des Geistes. von Dr. EUGEN KRÖNER. Breslau, 1887. pp. 207.

The point of view from which this work is written is that of the naturalist and the evolutionist. As an outcome of the modern biological renaissance there has resulted the science of physiological psychology. To ensure the progress of this movement up to the stage of the exact sciences, two methods must be employed, the experimental (psycho-physics) and the comparative (genetic.) The latter is the method by which feeling is to be studied. The chief problems are—(1.) What psychic activities has the new-born infant? (2.) How are the faculties of the adult evolved from these? It is soon found that these problems are insoluble without the consideration of the development of psychic functions along the animal scale. As in bodily so in mental evolution, the two progress in parallel lines. Häckel's biogenetic law that "autogenesis, or the development of the individual, is a rapid and condensed repetition of the phylogenesis, or the development of the species," must be applied to psychology. Hence the importance of animal psychology and especially does this hold of the study of the feelings.

The lack of this genetic method of regarding emotional phenomena is the common fault of all historical systems, and one of the greatest obstacles in the way of such a conception was the conventional trinity of faculties with reason as the chief and fundamental. From the genetic point of view, feeling is the primary fact of life. It is the fundamental property common to all irritable tissue. The differentiation of subject and object, on which all reason depends, requires a more or less specialized sense organ, and such does not exist in the lower forms of life. The lowest stage in this evolution is represented by the conæsthesic feelings (Gemeingefühl). These are caused by the getting into consciousness of physiological activities, and are characterized by their vagueness—lack of localization—and by being pleasure-giving or the reverse. The first days of infant life are spent in this sphere. (Romanes puts the psychic life of a new-born child on a level with that of the coelenterata.) The next higher stage appears in sense-feeling (*sinnliche Gefühl, betonte Empfinding* of Herbart), in which the pleasurable or powerful effect is the concomitant of a more or less definite sensation. The distinction between the two is considered of radical importance.

The filling out of this plan is done with as great accuracy as our present knowledge will allow, while the treatment is everywhere interspersed with useful illustrative details. Theory is not resorted to when facts are the criterion, nor is introspection—nowhere so dangerous an instrument as here—allowed to rule over objective verifiable truth. Dr. Kröner's book may be recommended as the

most useful compilation of this chapter of physiological psychology that has yet appeared. It owes much to the marked analysis of Horwicz, but differs from that author in several respects. A too frequent mention of Dr. Jäger is perhaps the only point of fault-finding which may safely be indulged in, without bordering on hypercriticism, which in this difficult field is especially out of place.

J. JASTROW.

Die Seelenblindheit als Herderscheinang und ihre Beziehungen zur Homonymen Hemianopsie zur Alexie und Agraphie. Von DR. HERMANN WILBRAND. Wiesbaden, 1887. pp. 192. 8vo.

No question in the study of localization of brain functions has called forth such a voluminous and violent controversy as that of the centres of vision. No other question has led to such important and suggestive conceptions of the nature of brain centres, or has been attacked by so many and such ingenious methods. When Munk destroyed certain regions of the dog's brain and found as the permanent result a loss of the memory-pictures of sight, while the animal used its eyes to avoid obstacles, etc., as before, he gave to this condition the name of "psychic blindness" (Seelenblindheit). The dog could see as long as his lower optical centres were intact; to recognize and interpret what he saw required the higher cortical centres.

A precisely analagous condition is produced by cortical disease in man. Dr. Willbrand gives two classical cases of this nature, one from Charcot's clinic, the other from his own. In both these cases the intelligence was intact and the description of the symptoms by the patient extremely definite and valuable. Charcot's case is especially conclusive, because the subject of it possessed before his trouble a remarkable visualizing faculty. He could read pages of his favorite authors from the mental picture of the printed book which appeared before him; when he thought of a certain spot he visualized a complete colored photograph of it. During his attack all this had to be transferred to the ear, and to remember anything he had to repeat it *aloud* to himself.

The conclusions to which Dr. Willbrand's study leads him are briefly these: If the conduction of impressions along the optic tract be hindered, blindness in the ordinary sense is the result. But visual hallucinations, dream-visions and subjective light sensations are possible, and the memory of the world of sight remains. If the perceptive centre of one hemisphere is destroyed, unilateral cortical blindness ensues, appearing as an absolute and complete hemianopsia of the opposite holds of the field of visions. If both hemispheres are thus affected, hallucinations and subjective vision are impossible, but the memory of seen objects need not be impaired.

If, however, it is the "optical memory areas" that are affected, form and color may be seen, but they make an unfamiliar impression. The visual phantasy gradually atrophies, and dreams become visionless. Subjective light-impressions remain. It must also be remarked that these phenomena are liable to complication by loss of names for visual objects.

Dr. Willbrand's book will take its place amongst the most valuable contributions to this intricate subject, which perhaps more than any other offers a promising path to a deeper knowledge of

the nature of psychic functions. The value of the book is enhanced by a chapter describing the process of learning to see in those who, born blind, have been restored to sight.

J. JASTROW.

Physiologische Studien über Psychophysik. Von DR. FRANZ CARL MÜLLER. Archiv. für Anat. u. Physiol., Heft III. u IV. 1886.

This third German investigator of his name in the field opened by Weber's law, attempts to determine how the negative variation needful to excite a just observable contraction is related to absolute intensity of the [ascending] current. For this purpose a single pair of unpolarized electrodes served for the permanent and for the reversing current in such a way that when the contact was closed the currents were separated and compensated; when it was open they combined, causing a negative variation. The sciatic nerve of a frog was first observed, and the minimal contractions of the toe-muscles directly observed. The quotient of the intensity of the larger current (measured in divisions of the current passed over by the needle of the galnometer), divided by that of the varible current, here measures the psychophysic relation sought. This quotient begins in feeble currents with a threshold intensity of unity, and increases rapidly to two or three times its initial value, and then remains constant for a time, till with very strong currents it sinks again. Although the first period of increasing differential sensibility is quite analgous to the lower limit of Weber's law, the second period of constant quotients, the extent of which differs for different nerves, is especially important. Very similar results were attained on rabbits and guinea pigs. Percutaneous stimulation by the same method on the motor points of various digital muscles in the human arm, gave results with somewhat greater irregularity, but with a long second period of constant quotients. Next, instead of just observable muscular contraction, just observable differences of sensation were attempted with similar results. From these experiments Dr. Müller feels himself justified in calling Weber's law only one [psycho-physic] case of a larger "neurophysic" law which applies to all stimuli that diminish excitability, and formulates his law as follows: "The excitation caused by a change of intensity of a stimulus that diminishes excitability remains the same (under conditions otherwise similar and within certain limits of absolute intensity of stimulus), if the relation of the change of intensity to the intensity on the basis of which the change is made remains the same. Outside these limits, with constant relation between intensity and change of intensity from one degree of stimulus to the next higher, an increase of excitation occurs with small, and a decrease with great intensity."

A sensation of difference which Fechner substituted for Weber's difference of sensation, is not a sensation at all, but a judgment. A sensation due to a constant stimulus is physiologically a state of diminished excitability. Changed excitability is thus an essential property of sensation which serves as an index to the inner dynamic, or neurotonic state of the nerve. The act of bringing two sensations, or even the memory of two past sensations into relation, or comparing them by alternating from one to another, is the simplest form of any judgment, and is physilogically represented by

excitation attendant on the transition from one state of excitability to another. As a state of reduced excitability, the psycho-physic process that underlies sensations is thus directly proportional to the intensity of the stimulus. By using as his stimulus the change from anelectrotonus to katelectrotonus, and correcting for the movement of the indifference point along the myopolar tract, Müller was able to study states of increased excitability, and the effects of transition from reduced to increased excitability, although in a preliminary way, respecting which fuller results are promised. His work is in the line of Dewar and McKendrick, Bernstein and Ward, indicating that the sensation is directly as nervous action, and that the logarithmic relation holds between the stimulus and the amount of neural excitation. He attempts, however, to subsume Fechner and Weber under the law of stimulation by changed electrotonic state. The author's fuller results will be awaited with interest.

Untersuchungen uber das Tongedächtness. Von H. K. Wolfe. Wundt's Philosoph. Studien. III. 4.

Dr. Ebbinghaus studied the function of memory as a reproductive faculty by counting the number of repetitions of a variable series of nonsense syllables, necessary to enable the learner to repeat them at will after a given interval, also subject to variations. Mr. Wolfe's study is upon memory as a recognizing faculty; evidently an easier and more extended power. In a second reading of a book, for example, we recognize as familiar much more than we could have repeated of the contents. The author used a series of nearly three hundred vibrating metal tongues, giving the tones through five octaves, and proceeding by intervals of two vibrations in the two lower, and of four vibrations in the three higher octaves. In the different series of experiments, certain of these tones were chosen as standards, and after sounding one of them for one second, a second tone, either the same or one differing from it by four, eight or twelve vibrations (higher or lower), was sounded at a variable interval, and the subject was required to say whether the second tone was the same or different from the first, and if different, whether higher or lower. Besides the answer could be "undecided," and also "different but undecided whether higher or lower." By adopting such a cumbrous method, and allowing the subject as many as five kinds of answers, Mr. Wolfe has very much diminished the value of his tables. For example, one of his strongest points is that we can tell whether two tones are equal more accurately than whether they are different. This does not at all follow from his tables. When the subject said "higher" or "lower," and was wrong, it may have been that the tones were really *different*, and thus the subject was only half wrong; *i. e.*, he recognized the difference, but not the direction of the difference. If we thus add the number of cases in which the direction of the change was recognized to the number in which the difference only was recognized, and estimate how many of the cases in which the direction of the change was misjudged, the fact of a change was recognized (on which point the tables are silent) as only one-half, it looks very much as though this statement did not hold. It is an excellent example of the mischievous effect of a poor method of experimenting or of stating one's results.

The general results of the paper, however, are probably not seriously vitiated by this inaccuracy, and may be summarized thus: The accuracy of the memory for tone sensations is very great; it is much more difficult to recognize the direction in which a tone has been altered than to detect the alteration itself. This seems to be a peculiarity of tone sensations, as it does not hold for sight or touch. The longer the interval between the sounding of the two tones, (variable from 1-30, 60, or 120 seconds), the smaller the chances of recognizing the tone; and this process of forgetting takes place at first very rapidly and then very slowly. It is made probable that the interval must increase in a geometrical ratio to produce an arithmetical series of (approximately) equal degrees of forgetting. A constant and peculiar deviation from this law occurs after an interval of 20-30 seconds; then there is a rhythm in the memory itself, and the curve of forgetfulness rises slightly. It was also noted that a low tone is not as easily recognized as a high one; that unmusical ears tend to judge low notes too low and high ones too high; that the effect of practice is at first marked, but soon diminishes, as is its general law; and, that the recovering power of the ear is so great that fatigue has little effect.

J. JASTROW.

The Conception of Love in some American Languages. By D. E. BRINTON. Proc. Am. Philos. Soc. December, 1885. pp. 536-62.

Dr. Brinton has studied the history and derivation of terms of affection as furnishing illustrations of the origin and growth of the sentiments of love and friendship; and has sought to show the parallelism that everywhere appears in the workings of the human mind. The principal words expressing love in the Aryan lanuguages can be traced back to two main ideas, one denoting similarity between the persons loving, the other denoting a wish or desire. The same notions underlie the majority of words expressing love in the American languages studied.

The following classification of the original modes of expression for conceptions of love is given, the names of the languages being given in parenthesis:

1.—Inarticulate cries of emotion, (Cree, Maya, Qquichua).
2.—Assertions of sameness or similarity, (Cree, Nahuatl, Tupi, Arawack).
3.—Assertions of conjunction or union, (Cree, Nahuatl, Maya).
4.—Assertions of a wish, desire or longing, (Cree, Cakchiquel, Qqueichua, Tupi).

W. H. BURNHAM.

Coma. By CHARLES MERCIER, M. D. Brain, Jan.,1887.

The writer, who avows himself a follower of Dr. Hughlings-Jackson, seeks to enforce Mr. Savory's proposition to restrict the present very vague meaning of coma to "cases where there is a state of insensibility from which the patient cannot be completely aroused, together with a tendency to death by asphyxia," except that for "insensibility" our author would substitute "evidence of defect of consciousness." This includes cases of partial consciousness and cases where consciousness may exist, but is not made evident by common tests. Four stages are distinguished. "The finest, most delicate and most elaborate movements and those associated with

the will are the first to go, while the simplest, broadest and most general movements, and those least associated with will are the last to be retained." Thus the drunkard looses the power to write first, then to talk clearly, then to hold his glass steady, then to walk, then to sit, and by the same law his breathing begins to fail, while his heart is unaffected, and the accessory parts of the breathing apparatus fail before the fundamental parts. Hence the tendency is to death by asphyxia.[1] Independent movement of the eyes, and especially divergence, is said to *always* occur in coma, and negative the possibility of hysteria. The ordinary fatigues of the day and a hearty meal check the most complex, delicate and precise movements of the mind. The same pathological event that enfeebles activity enfeebles mentation, and indeed every part of the organism. It is concluded that the highest centres represent in more or less degree every part of the organism. The functions of the brain are not "segregated in separated encapsulated portions of grey matter," and the doctrine of nerve centres "is rapidly becoming like so many doctrines before it, a fetishism." Obscure symptoms used to be called "reflex;" later they were due to "incoördination," a still more vague and sonorous expression of unusual cause, and now there are not only psychic, but trophic, and even glycogenic centres. To invent new centres *ad libitum* that may be both destroyed to account for defect and discharged to account for excessive action, shows how far localization has run mad. It belongs to lower and not to higher centres. The author's plea is for "universal representation of the highest nervous centres." This view assimulates coma to insanity as a "fulminating" form of it, and though the stages of insanity may be so prolonged that the relation of stages may be lost, both illustrate the one fundamental law of dissolution, and there is no form whatever of either that may not have its counterpart in a case of drunkenness.

Beiträge zur Kentniss der Militärpsychosen. W. Somer. Allg. Zeitsch. f. Psychiatrie. 1886.

The peculiar psychoses resulting from the excitement and fatigue of military life and war have never been adequately studied. During active campaigning the medical staff of the army is otherwise employed, and save a few treatises on the simulation of diseases by soldiers and recruits, the literature on the subject is very meager. The basis of this article is mainly the clinical records of the lunatic asylum for soldiers in Allenberg, East Prussia, yet here diseases which developed after discharge from the army are ignored. The consequences of insanity in the service are very grave, and it is much more frequent than in civil life. Most soldiers are able-

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[1]See the conclusions of S. Weir Mitchell and E. T. Reichert in their very valuable "Researches upon the Venom of Poisonous Serpents," Smithsonian contribution, No. 647, 1886, p. 50. "These results all go to establish the conclusion that the respiratory centre is the most vulnerable part of the nervous system, that the coördinating and volitional centres are then prominently affected, that the sensory part of the spinal cord and sensory nerves are next attacked, and that the motor parts of the cord and the motor nerves are the last to succumb."

bodied, and between 20 and 25 years of age. From statistics gathered from various sources Somer concludes that the morbidity for psychic diseases is 0.027 per cent. for German infantry, 0.033 for Austria, 0.04 for France, 0.05 for Italy, and 0.16 for England. Long service in the colonies, involving fatigue in bad climates, are regarded as the cause of the high percentage for English soldiers. Psychic diseases are strikingly more frequent among officers than private soldiers. All these differences, however, between military and civil liabilities, are reduced almost to nothing in time of peace. The prevalent form of nervous disease resulting from war is paralysis, due to psychic and somatic exhaustion. Not only is war so deleterious in this respect that greater facility of exemption should be allowed those predisposed, but the prognosis of psychoses, due to active army service, is more unfavorable than for similar symptoms originating in civil life. In examining those entering the army, closest scrutiny should be given to the heredity and earlier life, with a view of reducing the too large percentage of military psychoses.

Die punctiförmig begrenze Reizung des Froschrückenmarkes. W. Sirotinin. Arch. f. Anat. u. Physiol. 1887. pp. 154.

It was known from careful series of investigations that when a stimulus is applied to the central end of the spinal cord, regular movements in the limbs are caused by means of nerves of deeper origin belonging to the lateral, and probably parts of the anterior tracts. Conversely stimulus of the lower end of cross-sections of the cord causes reflex movements by means of motor nerves from roots above. Finally it is known that a very brief stimulus of the ganglion column of the anterior horn causes strong and prolonged tetanizing effect in the nerves that originate here. The author, working under Ludwig's direction, devised the following ingenious and more exact method of extending our knowledge of the cord. The cord of the frog was well exposed from behind along most of its length. A sewing needle of smallest size was sharpened for three mm., with a lancet-formed blade, and of such size that the half of an average cord could afford room for ten thrusts, side by side. An average stab of one-tenth of a millimetre in depth would cut or dis-displace sixty fibres. The effects of these lesions were recorded on three muscles, the illeopsoas, semitendinosus and gastrocnemius. Of these the first was most sensitive from the second to the fourth vertebra, where its sensitiveness culminated and below which it rapidly declined. The second began to increase with the third and reached its maximum at the fifth vertebra, and the last reached a maximum of 100 per cent. at the seventh vertebra, where that of the first had sunk to 38. Almost the same law was observed, when, instead of sensitiveness, the heighth of the contraction of the muscles, or the order in time in which they began to contract, was observed. More complicated were the comparative results of the lateral stimulus of the posterior and anterior halves of the cord at different attitudes. Electrical stimuli were also applied with similar results. Incidentally an important observation was made that indicated a peculiar relation of the most outer part of the lateral column, the stimulus of which regularly affected the muscles of the same side, indicating that if the grouping is the same by mammals as

in the frog, these fibres cannot belong to pyramidal tracts. This result is incomplete and further results in the study of localization are expected by refinements of this method, and by applying it to the cord and perhaps even to the medulla of mammals.

Note on the Special Liability to loss of Nouns in Aphasia. By MARY PUTNAM JACOBI, M. D. Journal of Nervous and Mental Disease. N. Y., Feb., 1887.

From the record of one hundred and sixteen cases seventeen were found by the author to have lost only the memory or the power to employ nouns. Children are often said to learn nouns first, and they should therefore be most deeply organized, and, on the commom theory of devolution, the last to disappear. The records of autopsies shed no light on partial as distinct from total aphasia. Hence the author turns to the great discussions which have raged about the psychology of the naming process. Of course ideas are not held from the author's standpoint to have anything archetypal about them in the sense of Plato or the scholastic realists, but to be gradually formed by the fusion of visual, tactual and other impressions. For this product the terms *conception* and even *mental image* may be used by alienists so strictly as to realize the ever-lurking danger of realistic tendencies. The author agrees with Hughlings Jackson that a method which is founded on classifications which are partly anatomical and physiological, and partly psychological, confuses the real issues, and with Whitney that a word is simply the survival of the fittest among a variety of resources (gestures, etc.) for effecting the same purpose, viz.: fixing the mental attributes of an object, but prefers to use molecular and anatomical methods and terms, and considers that physiology on the whole favors nominalism. The author infers that the reason nouns are likely to be lost first and easiest in progressive aphasia is because they are most easily replaced by visual images, and adds in the last paragraph that it had been "suggested by a friend" that abstract nouns ought to be longest retained, and concludes that it would be interesting to test this suggestion. The suggestion has been made before, but not that we remember tested. If true, it does not seem to us sufficient to account for those strange cases of what Gairdner calls "brain intoxication for one word," at least not for those rare cases in which neither showing the object nor repeating the name will enable the patient to utter the name, where in Kussmaul's phrase the impressive as well as the expressive tract is interrupted. Is it not as possible that in the cases of those persons who forget or cannot speak their own names or that of their friends, or place of residence, but still use abstract and more recently acquired terms, the former have become more automatic or relegated to lower or more isolated centres, and are less widely irradiated by association, and so can be more cleanly eliminated by focal lesions. The author's treatment of the subject is at least broad and suggestive.

The Human Color-sense Considered as the Organic Response to Natural Stimuli. Journal of Ophthalmology. September, 1866.

Retinal Insensibility to Ultra-violet and Infra-Red Rays. Ibid. December, 1886. L. WEBSTER FOX, M. D. and GEO. M. GOULD, A. B.

The worship of sun, light and fire is the theological, the theory of either waves and specific energy of retinal fibres is the metaphysical stage in the study of light. But no study of phenomenon

is now complete without the psychological processes involved in knowing them are included, and it is by thus extending the scope of relations that the third or positive stage of knowledge is reached. Retinal processes in color-perception are at root fine perceptions of thermal differences. Under the theory of specific energy the mind's work was given the eye to do. Color is then, *in toto*, a psychological phenomenon. The reason why the so-called primary colors stand out so distinctly in the regularly differentiated spectrum is because first, gold, fire and light have always attracted great attention, and these rays are nearly half the whole. They symbolize reason. Secondly, green represents about one-fourth the rays, and stands for the vegetable world, which symbolizes utility and labor. Thirdly, red is war and love. It appears in blood and is associated with all its symbolisms. Fourthly, blue is the sky, remote, of feeble intensity, and typifying spiritual life, duty and religion.

In the second paper, it is urged that the limitations in the range of color-perception at both ends of the spectrum, and the coincidence of its intensity with the thermal intensity of the spectrum, is because the supply of infra red rays is weak and inconstant (as is shown by a reproduction of Langley's bolometric curves), and such power would indefinitely complicate the retinal and cerebral mechanism, and because finer discriminations within the imposed limits will be more useful to men. The authors write with a wide and suggestive range of reference and allusion to which justice cannot here be done, and one is often reminded of the "etherism" of the late Phillip Spiller. Both articles are disfigured by a number of misprints.

School-Training of the Insane. By J. G. Kiernan, M. D., Alienist and Neurologist. October, 1886.

At an early period school-teaching was introduced into some American asylums. Thirty years ago Dr. Brigham thought great advantages had resulted from winter classes in the Utica Asylum. Writing, drawing, painting, mathematics and modern languages were taught, and even a journal was published by the inmates of a well-known asylum. It was thought to beguile the melancholy, occupy those who had recovered but lingered at the asylum for fear of a relapse, support those tending to dementia, and to help the convalescent. Need of fit mental occupation was felt to be one of the most pressing wants of insane hospitals. Dr. J. P. Gray and his school, starting from the correct premise that insanity was the expression of a physical disease, wrongly inferred that moral treatment was useless, and largely through their influence moral treatment fell into disuse. In many European asylums instruction, sometimes mental, sometimes by special teachers, was quite often found salutary for diversion and exercise, till under the influence of the extreme somatic school of Jacobi they declined everywhere, save in Ireland. Dr. Lalor's systematic plan, carried out in the Dublin Insane Hospital, where six regular teachers were employed, has met with wide approval, especially to relieve the gloomy monotony of county asylums. In many cases, especially those of *folie avec conscience*, vigorous healthy conceptions of an intelligent teacher or attendant, no doubt do tend to the recovery of patients, and the closer the contact the stronger the influence. Even Krafft-

Ebing approves Leuret's method of conquering insane conceptions by intimidation if arguments fail, and supplementing this system by school-training to change the current of thought and introduce new healthy ideas. A case is cited where a patient was cured of a tendency to repeat words and phrases by memorizing verses. The basis of this treatment is related to the principle that a shock to one's prejudice leaves the mind open to the influence of new ideas. The article closes with three interesting cases.

Muskelthätigkeit als Mass psychischer Thätigkeit. Forlaüfige Mittheilung. Von Dr. J. Laub. Pflüger's Archiv. 1886 [Dec].

The writer attempted to determine, by experiment, how much a given muscular action was reduced when a given psychic activity occurred at the same time. A maximal muscular clench was recorded on a dynamometer. Then after a rest the dynomometer was again taken in the hand, and some mental activity was begun, in the midst of which a maximal pressure on the dynamometer was again attempted, and found to be much less than before. The mental work done was mainly reading (so as to reproduce in substance), and mental multiplication of numbers of two figures each. The more intense the physic action the slighter is the contractive energy required to cause tremor. The relative effects of thought on the available power of the right or left hand respectively was also taken into account, and the whole study is subsumed under the principle of the constancy and equivalence of force. It has long been a desideratum in work of this kind to have a dynometer invented which can register fine differences of pressure when the absolute pressure is great, and, as Dr. Laub states he was engaged for a year on the problem of dynamometry, we may hope that when the full account of his work appears he will be found to have solved this problem, as well as to have overcome the manifold sources of error which will occur to physologists who read his preliminary statement.

Du Diagnostic Medico-Legal de la Pyromanie par l'examen indirect. E. M. deMontyel. Archives de Neurologie. January, 1887.

In this long and valuable article, pyromania is limited to acts caused by irresistible impulse without sensory delusions or deliriums. Tenacity in denial, so different from the often prompt self-accusation of the impulsive homicide, who often feels the impulse and wishes to be restrained from its power, which the pyromaniac never does, may be due to the fact that pyromania chiefly occurs among the lower and feebler classes, whose favorite weapon is deceit. Thus direct examination of pyromaniacs is little to be relied on. Again, the presence of any motive is held to vitiate the claim of alienation as an excuse for such an act, though its absence does not establish it. The pyromaniac is rarely detected before having caused several conflagrations. Pyromaniacs are comparatively unknown in the city. Their acts are commonly done on sundays or holidays, or at the close of business hours. Very inflammable material which strongly suggests the approach of a match, especially tempts them. Thus occasion and probable security are dangerous. He does not fly, but is often the first to give alarm, and work devotedly to extinguish the flames. The disorder tends to appear at puberty and again in the climacteric. It is almost always attended by mental weakness. As pyromaniacs rarely incriminate themselves, it becomes the more important to study the many indications by which the diagnosis can be made, by indirect examinations. Six interesting new cases are described.

Ueber die Anwendung der Methode der Mittleren Abstufngen auf den Lichtsinn. Dr. A. Lehmann. Philos. Studen, 4 Heft. 1886.

The single careful study of this fourth psycho-physic method of average gradation made by Delboeuf, seemed to Dr. Lehmann, working under Wundt's guidance, inconclusive as to the validity of the method. Accordingly, he constructed three large disks of 10 cm. radius, each rotating independently by clockwork. One of these disks had of its four sectors the two alternate sectors black. By a pair of double sectors, one black and the other white, the shade of the other disks could be varied. The problem was to get the sectors of the middle disk, in a room uniformly lighted artificially, so that its shade seemed about midway between that of the other two. The first result showed that it made a great difference in judging whether the quantity of light from the middle disk was gradually increased or diminished. The conclusion of a long series of experiments was that the influence of contrast cannot be excluded, and vitiates the method of average gradation. Contrast could only be excluded by having a background for the middle disk that should always have the same degree of brightness as it has, changing with it, and the three disks must have such a distance between them as to exclude reciprocal contrast. Whether these difficulties can be overcome, can only be ascertained by further experiments.

Ueber die Theorie des Simultanen Contrasts von Helmholtz. E. Hering. Pflüger's Archiv. 1887. pp. 172.

Helmholtz's theory of simultaneous contrast seems to its author to have one of its strongest vouchers in the following experiment with colored shadows: Let a white surface be illuminated by a feeble ray of daylight and also by the reddish yellow light of a candle or gas jet, and let each cast a shadow upon this surface. The shadow of the first is yellow and that of the latter is blue, although it falls on a spot which receives only daylight. This is partly due to successive and partly to simultaneous contrast, and the former is readily eliminated. If the shadow cast by the gas is viewed through a tube so directed that the eye sees only a field within the gas-shadow, it does not seem blue, but does so if a part of the field lit by the gas is seen, adds Helmholtz. Hering, however, declares that this subjective blue is in no sense a "judgment," but is a regular phenomenon of successive contrast, and also that Helmholtz has made a similar error respecting the disappearance of the blue when the tube is laid aside. Hering proceeds to give an elaborate modification of this experiment in three phases, the description of which involves many pages, and which seems to show that the purely psychological explanation of this phenomenon should give place to his own physiological interpretation.

A Contribution to the Pathology of Dreams and of Hysterical Paralysis. By Ch. Féré, M. D., of the Bicêtre Hospital, Paris. Brain. January, 1887.

It has been repeatedly observed that hallucinations that begin during sleep and are reproduced for several nights consecutively, end by being received as realities during the daytime. Diurnal delirium and even suicidal and homicidal impulses have been observed after two or three nights of dreaming. A single dream

sometimes sets up a mental disturbance that manifests itself the next day. A special relation between dreaming and alcoholic delirium has also been noticed. Dreams may play an important part as a determining cause of epileptic attacks. Nocturnal hysterical fits are sometimes determined by terrifying dreams. A remarkable case of psychic-paralysis due to the same terrifying dream for several successive nights is described. The same patient afforded also a good example of fatigue-paralysis, becoming incapable of phonation after the discharge of another centre. The author concludes that dreaming, and especially repeated dreaming, must not be considered an indifferent phenomenon, but may constitute the opening scene of a morbid drama. The reader would probably ask Dr. Féré whether such dreams as he describes were not caused by the paralysis, and not conversely as he assumes.

Onamatomania. CHARCOT and MAYMAN. Archiv. of Neurol. 1886.

A group of symptoms is designated where a single word plays an important role, often causing anxiety, and co-existing with habitual dubiations, fear of contact, or inverted sexual sensations, etc. (1) A single word or name may be irretrievably forgotton; (2) the patient may be impelled to continuously repeat a word; (3) in conversation certain words are emphasized; (4) certain words are used to check the effect of other accidental expressions; (5) as a word may seem to be accidentally swallowed, and great effort is made by hawking and spitting to bring it forth from the stomach. In such cases the patient has full consciousness of his state, and knows his enslavement to these tyranous impressions. Seven cases are described where the loss of a word caused great disquietude, and when it was found another was lost, and lists of words were made out and kept at hand for relief.

Experiments on Prehension. J. JACOBS. Mind, Jan., 1887. With Supplementary Notes on Prehension in Idiots by FRANCIS GALTON.

In these experiments the "span" of "prehension" is measured by the number of letters and numerals that can be correctly repeated after twice hearing, the interval between them in the dictation being about one-half a second. Ebbinghaus's nonsense syllables we at first tried, but rejected because they were found to distract attention and to be too variable in ease of pronunciation, rythm, degree of novelty and grotesqueness, etc. Numerals are not only fewer than letters, but have less associations by contiguity. Between the ages of eight and nineteen the span of school-girls increases from 6. to 7.9 for letters, and from 6.6 to 8.6 for numerals. Span increases not only with age, but with rank in class, and it is suggested that a "standard span" be added to the items for anthropometric measurement. Mr. Galton found greater individual variation in idiots, but less average span than in normal children.

Ueber Ziele und Wege der Volkerpsychologie. W. WUNDT. Philos. Studien. Heft 1. 1887.

The comprehensive program of Volks-psychology given by Lazarus and Steinthal, in the first volume of their journal makes it include language, religion, myth, customs, art and history, and contrast it with individual psychology. As descriptive natural history is illustrated by physics, chemistry and psychology, so history needs

a kind of natural history of mind, to which philologists and historians furnish raw material. H. Paul's division of all sciences into two classes, those of law and those of history, is less metaphysical. There is in fact no agreement what Volks-psychology, which is now separating itself from anthropology and ethnology, as these did from natural history, really is. Wundt thinks it should occupy itself exclusively with the three topics of *speech*, *myth* and *customs*, and as such, supplement individual psychology. Custom is the germ of law and shows primitive directions of the will; myth is the expression of living contents as conditioned by feelings and instinct; and language is their form, their laws of union.

The Science of Folk-Lore, with tables of the spirit basis of Belief and Custom. R. C. Temple. Folk-Lore Journal, September, 1886.

Folk-lore is defined as popular learning. The embodiment of popular ideas on all matters connected with man and his surroundings, or the popular explanation of observed facts. Its source is the instinct to account for such facts, and many customs have arisen therefrom. There is need of a standard manual showing just what kind of facts are wanted, and how they should be recorded and classified. The powers of imagination have been greatly overestimated. Its limits are conterminous with the bounds of human experience. Most of the customs of wild tribes, though coarse and strange, are sensible, and based on experience of what had stood them in greatest stead in the fight with disease and death. In conclusion, "demology" is suggested as a synonym of folk-lore, giving better derivitive forms, and a folk-lore library and museum, a better classification of proverbs, index of literature, a unification of the several discordant plans for studying it that have been put forth, are desiderated. The table is well calculated to show how many beliefs and customs are due to beliefs in spirits of many kinds.

Note sur un Charactére Différentiél des Écritures. J. Hericourt. Rev. Philos., May, 1887.

All movements of the hand from left to right are dextrogyric and those from right to left are sinistrogyric. Curves with their convexity upwward are centripetal, with the convexity below centrifugal. These designations may be used to characterize all movements, and, as Delaunay has shown, individuals and special groups of movements are characterized by the predominance of one or another of these traits. So in writing, dextrogyric may reduce, suppress, or even replace sinistrogyric curves, and each may be more or less exaggerated. In returning curves it is the first movement of the hand that is significant. The psychological interpretation of peculiarities of script, judged by these rubrics, is that dextrogyric writers, who not only in general stretch out letters rapidly toward the right, the direction of writing, but suppress sinistrogyric qualities, indicate superior psychic qualities. This conclusion is confirmed by experiments on hypnotic subjects under the influence of suggestion, illustrations of which are appended.

De l' intoxication professonnelle des dégustateurs de vins et de liqueurs. Dr. Donnet. An. Medico-Psychol. Jan., 1887.

As the symptoms lately grouped as tea-ism are sometimes produced both by drinking and tasting tea, so Dr. Donnet gives three cases of young men selected as tasters by the great dealers in wine

at Bordeaux, who were not drinkers, often swallowing only the best of the wines they applied to their lips, but who developed gastric and cerebral symptoms of chronic alcoholism, which were ameliorated on abandoning their duties as tasters. Wealthy people of Bordeaux are described as making wine a veritable cultus in the sense of having the most exqusite tastes for grades and varieties, having a special vocabulary for expressing faint nuances of tastes, and sometimes as consuming large quantities. Dr. Monache is made responsible for the statement that there are more deaths by apoplexy in Bordeaux than in any city of the world.

De la degustation des vins en Bourgogne. E. Marandon de Montyel. An. Med.-Psychol. Jan., 1887.

A broad distinction should be made between professional tasters, most of whom, in Bourgogne, do not swallow a drop of the wine they taste, and sometimes rinse the mouth with water, and amateur or occasional tasters who swallow, and who soon, and after a surprisingly small quantity, experience symptoms of intoxication. The former can pursue their vocation all day without inconvenience. Those who swallow sometimes lapse to chronic alocholism. The former sometimes acquire a disgust for most or all forms of alcohol. Those who have been wont to taste red wines and pass to white wines, often experience unfavorable effects. It is, however, tasters of tea and those kinds of white wine that need to be swallowed to be finely tasted who are most liable to professional intoxication.

L' encéphale, structure et description iconographiques du cerveau du cervelet et du bulbe. E. Gavoy.

The atlas part of this admirable work consists of fifty-five plates, drawn and reproduced by glyptography, of brain section only one millimeter apart, thirteen being sagittal, twenty-three being frontal, and the remainder horizontal. We are not told how the brains were prepared, the kind of cerebrotome used, nor the kind of bath in which the fresh sections were immersed. The fibres are much more distinctly brought out than in Professor Dalton's similar series of sections of frozen brains directly photographed. The labor involved in the work of M. Gavoy must have been great. The text is introduced by a general account of the nervous system, and comprises altogether over 150 pages.

Die Messung von Schallstärken. Starke. Philos. Studien Heft III. 1886.

By the aid of an ingenious mechanical device of Wundt, Starke showed that of two successive like sounds the second seems regularly greatest, perhaps on account of the rapid fading of the memory-image of the first, or perhaps by reason of the persistence of the first stimulus. This fact has entered as a source of error into nearly all previous measurements of sound. Eliminating this, the much doubted law of a simple proportion between the strength of sound and the product of height and weight is strictly valid, and thus Weber's law holds here within wide limits.

Der Sachverständige und der freie Willensbestimmung. SCHAFER. Viertlejahrsch, f. Gen. Med. N. F. XLV.

The author directs a vigorous polemic against Mendel, who holds that the diagnosis of insanity involves irresponsibility. Schaefer claims that such diagnosis *in foro* does not suffice, because insanity in a scientific and in a juristic sense by no means coincide, and a patient may be insane and at the same time responsible. Only the physician can decide at what point responsibility ceases, and this is not involved in a verdict of insanity. The doctor does not pass beyond his sphere in investigating the general psychological idea of free will.

Eine Karte des Menschlichen Auges. W. FLEMMING. Braunschweig, 1887.

This chart is a very careful delineation in colors of a vertical section of the human eye thirty times enlarged. The normal proportion of parts and dimensions is preserved so far as the scale permits, and we have already found it of great pedagogical utility in the class-room. It is accompanied by a pamphlet of explanatory text.

NOTES.

A permanent international ornithological committee, under the patronage of the crown prince Rudolf of Austria, has already begun the systematic collections of data on bird-psychology, including nest-building, brooding, feeding, uses and injuries, relations to their friends and foes, habits known to hunters, popular names, but more especially their migrations. A special journal, *Ornis*, was begun in 1885, and is largely devoted to the publication of these data. Observations from eighty-three stations are reported in systematic geographic order, which so far include three hundred and fourteen species of birds. Two annual reports (Jahresberichte) of naked observations have been published.

The Medico-Psychological Association of Great Britain and Ireland have instituted examinations for "certificates in psychological medicine." These examinations were based on three months' experience in asylum work, or lectures for a like period, and are both oral and written. Only physicians were admitted, and its certificates were sought not only by those desiring lunacy appointments, but as guarantees of the fitness of practitioners to deal with mental cases and sign medical certificates. The Gaskell memorial fund has since been applied to a prize for excellence in these examinations. It amounts to one thousand pounds, and two years' residence at an asylum is now required. The subjects for the annual honors examination, are four: 1. Healthy and morbid histology of the brain and cord. 2. Clinical cases, with commentaries. 3. Psychology, including the senses, intellect, emotions and volition. 4. Diagnosis, prognosis, pathology, treatment and medico-legal relations of mental diseases.

The Senate of the London University introduced for the first time in place of the old examinations in logic and psychology in the M. D. course, the subject of "mental physiology especially in relation to mental disorders." In 1886, the old subjects were also allowed as an alternative, but in future they will disappear. We cannot agree with the Journal of Mental Science that the examinations should be made to conform with that of the Medico-Psychological Association, but hold conversely that normal mental physiology should form one of the bases for the study of mental disorders.

The committee having the Belhomme prize in charge, consisting of M. M. Bouchereau, Dagonet, Fèrè, Foville and Sèglas, announce the following subject: "Investigation on the question whether there exists any emotional, physiological or psychological signs peculiar to criminals." Manuscripts must be in by the last of December, 1888.

Among the useful translations published in whole or in part in *The Platonist* since January, 1887, when the journal, now in its third volume assumed a new and better form, are the commentary

of Proklos on the first Alkibiades, Iamblichos on the Mysteries, Synesios on the Philosopher's Stone, the eleventh book of the Metamorphosis of Apuleius, the life of Hai Ebu Yokdan. The April number contains a plea for the establishment of a school of philosophy, chiefly to be devoted to esoteric theosophy, to be located at Los Angelos, California.

Archiv. fur Geschichte der Philosophie is the title of a new quarterly to be edited by Professors E. Zeller, L. Stein, H. Diels, Dilthey, and B. Erdmann. The history of philosophy has hitherto had no proper organ. Articles on these subjects must be sought in philological and theological, as well as philiosophical reviews. These are to be united in the new review, and speculative articles will be excluded. Contributors may write in German, Latin, Italian, French or English. About half of each number of the review will be devoted to notices of current publications bearing on the history of philosophy. Each number will contain about 150 pages. All communications should be addressed to E. Zeller, 4 Magdeburger Strasse, Berlin, or to L. Stein, Universität, Zürich.

In a brief article in the Journal of Nervous and Mental Diseases, December, 1886, Dr. Spitzka, concludes from the study of a cat which had been kept alive three months after the destruction of its entire left cerebral hemisphere and thalamus, that there is "a system of fibres intermediate in position between the pyramid and interolivary tract, and decussating with the former, apparently derived from the neuclei of the posterior columns, and running with the latter on its cephalic course. It was probably the discovery of similar fibres that led Meynert into the formation of his well-known but now abandoned view, regarding the sensory and motor decussation of the pyramids." This would prove that these tracts contain fibre admixtures from other sources than those from which Flechsig exclusively derived them.

During the twenty-four years ending 1887, Dr. Allen Starr, of New York, found 160 cases of cerebellar disease reported in American literature, in 40 of which symptoms and autopsies were described sufficiently well to warrant conclusions. In these there was: headache in 26; insubordination in 25; vertigo in 20; vomiting in 18; blindness in 14; dim vision in 6; diplopia or strabismus in 7; deafness in 7; hemiplegia in 9; mental symptons in 8; partial paralyses in 4; facial spasm or parerves in 4; stupor in 7; convulsions in 1; mania in 1; sexual excitement in 2. Four interesting cases are described in detail in the same journal, (The Journal of Nervous and Mental Diseases, April, 1887), by Dr. Seguin.

J. H. Lloyd, in a thesis for admission into the American Neurological Association, published in a late number of the Journal of Nervous and Mental Diseases, after a long exposition of the mischief of metaphysical abstraction in the study of mental phenomenon, concludes that the doctrine of moral insanity implies that there is a distinct moral faculty in the sense of a distinct agent which may become diseased without at all affecting the health of other faculties. It, and a big brood of special manias, is but the creation of bad science. He does not add that the "faculty" is also very differently understood according as the utilitarian or intuitional view is adopted, which is another argument against it.

Dr. R. L. Parsons, in the Journal of Nervous and Mental Diseases, April, 1887, summarizes the objections that have been so often put forth against the term monomania, and recounts the different senses in which it has been used since it was first introduced by Esqnirol. The term has been but slightly used of late in hospital reports in this country, and with little uniformity, because its literal and scientific meanings are so at variance. It is especially inconvenient where often used, viz.: in courts of justice. Partial mania and paranoia, which have been lately used in its place, are also unsatisfactory, and the term oligomania is proposed as a term whose obvious etymology best agrees with clinical facts.

Dr. Francis X. Dercum, in an article entitled "Facts and deductions bearing on the action of the nervous system," in a late number of the Journal of Nervous and Mental Diseases, concludes that considerations of embryology and comparative anatomy, and various facts derived from other sources, point to the conclusion that the nervous system, though inextricably complex, and composed of an almost infinite number of parts, acts as a whole, and that its parts are so closely related and interdependent that no one part can move unless every other part, no matter how slightly or how profoundly, moves also.

Dr. M. Allen Starr, in the Journal of Nervous and Mental Diseases for February, 1887, urges the more general employment of charts, like those of Erb, of electrical reaction, especially in paralytic and allied disorders. The author even thinks that in recoverable cases these curves enable prognoses as to the date of recovery to be quite exact. A simple chart is given for illustration, made by the aid of an absolute galvanometer in Milliamperes. The too common method of basing comparison on the number of cells is fallacious, as their strength is too variable.

Dr. Orgeas, in his book entitled *La Pathologie des Races Humaines et la Probleme de la Colonisation*, has rendered a real service to anthropologists and sociologists. A vast variety of facts is passed in review to illustrate the biologic principle of the non-cosmopolitanism of man. Permanent changes of latitude and climate are not permitted without deterioration. A change of residence brings artificial conditions of life. The physical differences in men are due to adaptation to different environments. The comparative pathology of different races is passed in review, and an important role is ascribed to it in determining the main facts of history. What races can best be adapted to what alien climate and by what adjustments this adaptation can be made with least loss, is fast becoming a grave problem in European statesmanship.

Dr. Gellé prints in *L'Encaphale*, 1887, No. 1, an interesting abstract of some observations made by himself on the role of the sensibility of the tympanum in the orientation of sound. A subject of Charcot's, on whom the first observation was made, was afflicted with general anaesthesia of the skin, extending to the external meatus of the ear and to the tympani of both ears, which were absolutely insensitive to contact or to pain, while light and hearing were intact, and the patient preserved his intelligence entire. With the eyes closed he could hear well the tick of a watch, but found it impossible to tell on which side or in which ear.

The experiments were repeated on this and other subjects suffering from general dermal anaesthesia, and always with the same result. Hence it is inferred that the sensibility of the tympanum is stimulated by the vibrating current, and hence comes not only the sense of direction, but of exteriority.

A recent visit to Gheel is reported in the Journal of Mental Science by Dr. Hack Tuke. The town now contains about 3,000 houses, about one-third of which receive lunatics, of which, including a few in a small asylum recently built for those of dirty habits, there are now over 1,600. The colony is under the general control of seven commissioners, who meet quarterly and report to the minister of justices, and is divided into two wards, each under a physician. Some of the cottages where the poorer patients are taken in and boarded are very humble. In the latter houses, where several patients are boarded out, is a special attendant. The highest sum paid is 200 pounds per year. The place is not very cleanly, and police regulations do not prevent the patients from entering public houses where drink is sold. The patients are mostly employed in some sort of labor, and offenses against morality are rare. There has been no homicides since 1850, and no fires set by patients for many years. Suicides have been rare, and there have been but three or four illegitimate births for the past ten years. Only sixty patients are in the asylum itself, which was opened only in 1861. The town was famous as a resort of lunatics in the fourteenth century. The church of St. Dymphna, built in that century, still contains the sick chamber where spiritual treatment was administered to lunatics. An iron chair, attached to a bedstead for restraining patients during the night, and iron rings are in the floor near the fire-place, to which the patient's chair, if not the patient, is secured. Dr. Tuke and his party were impressed with the economy and the moral effects of this system. The success of it cannot be judged by the "Scotch system" at Kennoway in Fifeshire, which is in many respects modeled after it. The latter is far smaller, is made up mostly of chronic dements, but the patients are more widely scattered and more intelligently supervised. The writer concludes that on the whole the plan is not desirable on any large scale in England, among other things, for the detriment it involves to the domestic life of the family which takes charge of the lunatic.

Dr. Francis Warner's "*Physical Expression*," vol. 52, of the international science series, is an original work of much value to the psychologist. The study of motor functions seems more likely to the author to lead to practical results than the subjective process of interpretation of feelings. People fitted for self-analysis are few and peculiar, so that only the small part of the field representing this coincident peculiarity has been worked over by this method. His method for screening different parts of the face is to cover the adjacent parts with a sheet of paper. Irritability in children causes the head to rotate, expressing negation, and drill in flexion, or nodding the head induces a state of acquiescence. The relation of hand postures to diseased states, and how to get the expression of mental action long before speech can disclose it, are points yet to be studied. The study of physiognomy apart from the rest of the body is an error.

At a meeting of the *Société de Psychologie Physiologique* Feb. 28, 1887. M. Babinski presented the results of experiments on an anæsthesic subject illustrating the survival of knowledge of the limbs and knowledge of movements accomplished after all dermal sensibility had been totally lost. With the eyes of the patient bandaged the arms could be placed in any position without any knowledge on his part of a change of place. If his eyes were closed while his hands rested on his knee, they could be lifted above his head afterwards and he believed they still rested on his knee. He was very clumsy and things slipped from his hands. With an arm elevated by a weight and pully, and being told to touch his knee, he felt for it about his shoulders. The time taken to affect movements and modifications of respiration seems the only basis of such rudamentary judgments of the position of his limbs as still remained.

Among the conclusions drawn by Dr. Descourtis, in a recent article on the cerebral thermometer, are the following: Sometimes the temperature reaches its maximum in fifteen or twenty minutes, and sometimes three or four hours are required; sometimes the temperature itself, or its slow increase or decrease, is constant, but often presents oscilliations which are commonly not regular, and sudden falls without known cause often occur. The temperature of the two sides often varies independently, and this difference seems greatest at low temperature, and sometimes it may rise on one side and fall on the other.

In an extended series of experiments on the mental representation of space, in connection with the feeling of effort, in the Rivista di Filosofia Scientifica, Mar-Dec. 1886, E. Morselli reproduced lines of various lengths with eyes open and closed, from which he concludes that the pshcho-physic law of the distribution of particular values about a mean hold of representations of space; that the tendency to increase small and diminish large distances holds of space as of time; and that the loss of spacial representation after a time illustrates the loss of memory, and proves that the concept of space is a product of habit and motor experience.

Dr. Paul Richer's Étude sur la Grande Hystérie ou Hystero-Epilepsie, is a work of great value to the psychologist, which, however, appeared too early for extended review in these pages, as it reached its second and greatly revised edition in 1885. Like Charcot, he ridicules the "pretendedly scientific skeptician," which ignores or even doubts the existence of the strange phenomenon here systematically described. Patients subject to these attacks were more common in France than elswhere, but it will be interesting to know if it may not also be observed in the Welsh and Irish branches of the Celtic Family. The stages to the description of which the work is mainly devoted are: (1) prodromata; (2) epileptic with tonic and clonic cramp, and relaxations or resolution; (3) contortions or clownism; (4) emotional and passionate attitudes; (5) delirium and hallucinations.

Dr. I. N. Ramaer, inspector of asylums in Holland, in an article on psychial analysis as the basis of morbid psychological diagnosis, urges that a careful study of the facts and laws of normal must

precede that of morbid psychology. The author starts with consciousness and thinks its origin is in the grey matter of the floor of the fourth ventricle, beneath the median groove. The just and important thesis that psychiatrists need psychology is not very adequately represented.

Bianchi (Arch. Ital. per le Mal. Nerv.) reports a grave case of hysteria, with hallucinations of hearing and visions, completely cured by a drastic course of moral treatment, which consisted in threatening an ovarian surgical operation with an elaborate display of apparatus, in applying a pretended cautery, really cold, to the abdomen, and in compelling the patient to appear in public at the moment of an attack.

Lussana (Arch. Ital. per le Mal. Nerv.) reports experiments on a surface of the outer part of the leg of a female patient of forty-five, who had lost the skin over a surface of 10 x 12 centimetres, from which he concludes that discriminative dermal sensibility is mediated by papilary bodies, particularly Meisner's corpuscles, but that the sense of material contact is independent of these bodies. The destruction of the skin and its nerves has no influence on the muscular sensibility of subjacent contractile bodies.

Vega (Arch. Ital. per le Mal. Nerv.) reports an interesting case of *folie a quatre*. The father of a woman of forty-seven was a foundling, who devoted much time and labor to find his true parents. She talked much of this, and at length thought herself the daughter and heir of high personages. This conviction she instilled into her mother (2) and into a lady whose servant she was, (3) and who identified a rich general as the father of her femme de chambre. The convictions persisted despite all disproofs, and when the author of the delusion married, her husband soon became infected with the monomania. The four had a course of similar hallucinations of hearing and general sensibility, erroneous interpretations, grievances, etc., and even after separation the deliriums continued, taking no account of the death of their assumed protectors and persecutors.

Algeri (Arch. Ital. per le Mal. Nerv.) reports with tables observations on 314 insane women from fifteen to forty-five, from which he concludes that the menstruration is almost always more irregular with insane than with sane women. In chronic psychopathies and in dementia menstrual disturbances are more marked than in melancholy and mania of recent origin. Menstruration generally coincides with psychopathic aggravation. This relation is best seen in periodic insanity.

Guicciardi and Tanzi (Rev. Sperim. di Fren.) tested the reaction time of fourteen cases of chronic hallucination of hearing with systematized delusion, and found it to be on the average 117.5 thousandths of a second, as compared with 119.5 in ten normal cases.

Tanzi and Riva (Rivista Sperim. di Fren.) observed 103 cases of systematized delusions among 729 insane patients, and infer that this psychophysic modality is less frequent than might be inferred from the prominent place it occupies in the body of psychatry. Women are less liable to it than men, and it develops especially at the

menopause. It is eminently a malady of degeneration, chronic, and of very long evolution. It is neither uniform in its progress nor is its form fixed, but its metamorphoses are extremely gradual. It is a perversion not an enfeeblement of the faculty of thought.

Amadei and Tonnini (Arch. Ital. per le Mal. Nerv.) have prepared the following classification of systematized delusions or paranoia. I. Degeneration paranora, on the basis of a congentially vicious organization, with somatic signs of hereditary degeneracy. Its development may be a. early, or b. late, and each of these may be (*a*) simple, *i. e.* with delirium of persecution, ambition, religion, love. On (*b*) hallucinnatory, *i. e.* the same as (*a*) with hypochondriacal symptoms. II. Psycho-neurotic paranoia. A. primary. B. secondary. Each with sub-divisions.

Baistrocchi (Rev. Sperim. di Fren.) has determined the weight of the white and grey substances of the brain by the aid of a Nicholson monumental aerometer in air and in distilled waters. The density of the entire encephalon in 21 men was 1.0265, in twenty-two women, 1.0338; of the spinal cord, 1.0387 for men, and 1.0448 for women. The grey substance of the cortex is lightest. Next comes the white cortical substance, the grey of the basal ganglia, the cord, the mid-brain and cerebellum which is heaviest of all. In general, density increases with absolute weight. It increases to the age of forty, and then steadily decreases, while the cord is at its maximal density in the fœtus.

Tamburini and Riva (Riv. Sperim. di Fren.) in sixty cases of general paralysis found lesions of the frontal lobes in 56 cases, of the parietal in 44, of the sphenoidal in 27, the temporal in 19, the occipital in 9, and the island in 3.

Morselli (Riv. Sperm. di Fren.) has applied the dynamograph of Régnier with registering apparatus to the diagnostic study of nervous disorders in diseases of the nervous system. The normal curve of the healthy subject is not very unlike that obtained from an excised nerve-muscle preparation; the neuropathic curves present many variations which are highly suggestive, but we opine, not sufficiently studied to present settled results as yet.

Musso (Rev. Sperm. di Fren.) examined the pupils of 70 epileptics and found them no larger than normal individuals. The diameter in sanity oscilates between 3 and 6 mm., with epileptics from 2 to 6 mm. The prodromal stage of convulsions is often signalized by remarkable difference between the diameter of the two pupils.

Adriani (Rev. Sperm. di Fren.) argues that the doctor should give the same care to the school that a mother gives to her child. Children with hereditary predisposition to insanity or general neural weakness, should not be educated in schools with perfectly normal children, but apart in special institutions, as they need prophylactic treatment.

A remarkable case of hereditary colored vision is described in The Rev. Philos. for Feb., 1887, in which a father son and daughter saw vowels and consonants similarly colored.

Liébeault, in his *Confessions d' un Medicin hypnotiseur*, recounts the different methods of producing hypnotism that he has used. Braid's fixation method was found occasionally to cause convulsions, and he recommends *gradual* suggestion, drooping of lids, falling of head, heaviness of lids, etc. Gradual awakening was also found far less productive of unpleasant sensations than if sudden.

Fioretti, in a late number of the Archivio di Psichiatria Scienze Penali, attempts to show that in normal, pathalogical and hypnotic cases the given and conscious motive is not the real cause of the act, but a mode by which the agent indulges the causal instinct, by explaining to himself conduct the primal source of which has escaped him. Thus the motive for a crime is not the absolute criterion of imputability.

Lombroso recounts some remarkable cases of memory of letters and figures impressed hypnotically, and enumerates the pernicious results of the exhibitions of the public mesmerist Donato at Turin alone as follows: One of his subjects was soon after attacked with paresis, another while at a theatre became cataliptic, another thought himself always hypnotized, another fell into epiliptic convulsions; a mathematical student could not adjust his compass without becoming cataleptic, and another must run after all carriages in the street with lanterns. All such public exhibitions, it is concluded, should be forbidden.

Danilewsky, in a late number of the Archives Slaves de Biologie, reached experimentally the conclusion that the stimulating influence which the hemispheres exert on the optic lobes, bulb and medulla is replaced, after ablation of the brain by increased excitability of these organs caused by excitations from the external world through the senses.

Jendrassik in two recent articles in the Archives de Neurologie, rejects the chemical vaso-motor and all other current views, and concludes that the cause of hypnotic phenomenon is loss or diminution of association.

Cappie, in Brain, July 1886, concludes that in attention the encephalic circulation is concentrated in certain cells, and as the quantity of blood in the brain cannot be increased or diminished other parts of the brain are depleted, In epileptic attacks, moter cells absorb the blood, leaving the cells in which consciousness subsists anaemic.

Ch. Richet, (Rev. Philos., Jan., 1887), describes the typography of certain neuropathic subjects which gets into print, and which, like their writing, is often marked by the most bizarre traits. In twelve lines eleven are different kinds of type; seventeen lines are from twelve different fonts, etc., and compares with this the style of a "certain contemporary school of poetry, the lines of which may be read in inverse order, so profoundly obscure is the sense.

In an experiment made on hysterical subjects in different states of hypnotism and echolalia, and lately reported to the French Society of Physiological Psychology, the reaction time from ear to mouth in the waking state was thirty-nine hundredths of a second; in somnambulism thirty-three, and in the state of echolalia, hypnotically induced, but thirty-one.

Peli compares the cephalometry of 670 lunatics with sane persons of the same class and locality, and finds the insane head is longer, higher and broader, and anomolies in the shape of the skull are three times as frequent, more so in males than in females, and mostly in hereditary forms.

Poggi examined the cerebral convolution of fifty brains of the insane, and found anomalies more common than in the sane, especially in the left hemisphere. The most frequent anomaly is a double calcarine fissure, or communication between the internal occipito-parietal sulcus and the sulci of the cuneiform lobule—40 per cent. Insane brains are particularly characterized by numerous anastomotic folds.

Dr. Legrain, in his Du Délire chez les Dégénérés, would substitute the term degenerative for hereditary insanity. He describes the physical and mental symptoms characterizing such cases, and describes them as very slowly evolving, taking on different forms sometimes in rapid succession, recovery from one followed by relapse to another, often attended by alcoholism and ending in dementia.

H. Beannis reports in a note in the Rev. Philos., March, 1887, the following experiment: The sensibility of the mucous membrane of the vocal cords of a singer was destroyed by cocaine without sensibly altering the accuracy of his song. From this he concludes that there is a muscle-sense which plays its role in giving accuracy to notes.

In a late number of the Medical Times Dr. L. W. Fox and G. M. Gould plead for a law restraining peddlers, jewellers and opticians from prescribing glasses. Many cases of injury, often permanent, to eyes resulting from errors thus made are cited, and it is claimed that legal restrictions are as much needed for the optician as for the druggist.

Bertillon proposes to identify criminals by measuring their height, the head, length of left arm and foot, and colors of the right eye. Altogether these measurements have already been the means of recognizing over seven hundred rearrested criminals without a single error.

Jeronimo Vida considers society an organism, the individuals composing which are related as cells in the animal body, and would thus approximate social and biological sciences. The social individual, however, is not the single person, which, unlike the physiological cell, lacks the reproductive function. This idea has been long ago worked out in far greater detail by Linienfeld, Espinas and others.

Dr. Christian argues, in a late number of the Journal of Mental Science, that general paralysis does not entail any increased fragility of the bones, and that osteo-malakia, when present, is the result of other causes. The great number of fractures in these cases is due to the great number of falls.

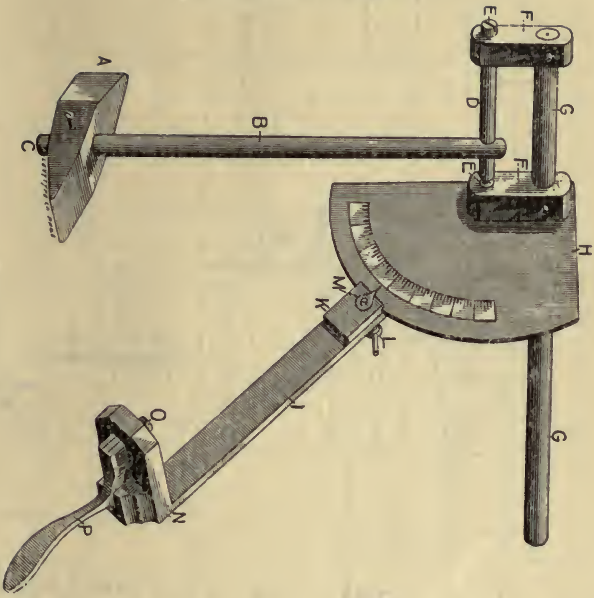
Dr. C. W. Cobbold prints, in the Journal of Mental Science, an elaborate plan, with cuts, of a model lunatic asylum for three or four hundred patients, with an interesting discussion of other plans.

Montegagga's *La Physionomie et les Sentiments* is not only a scientific but a most readable book. The cuts, by Hector Ximenès, are a new departure from the wearisome reproductions of Lavater, and the face is discussed feature by feature, in a way which marks an advance beyond both Darwin and Delsarte.

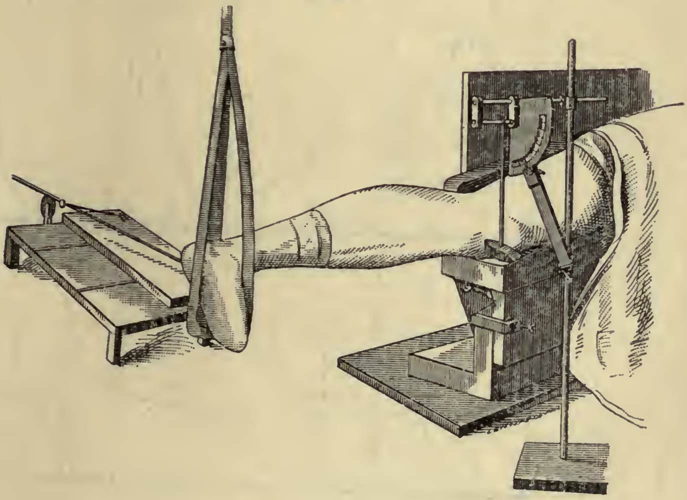
J. Heiberg's *Cutaneous Nerve Supply*, translated into English by Wagstaffe, is a small, useful book for both students and practitioners. The plates are a judicious compromise between plainness and literal reproductions from nature.

Lengelmann's *Idiotophilus* is a new, valuable and comprehensive work on idiocy by an eminent specialist. It is on the whole the best general treatise on the subject since Seguin.

PLATE I.—Fig. 1.



a Fig. 2. *b*



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ON THE RELATION OF NEUROLOGY TO PSYCHOLOGY.

BY HENRY H. DONALDSON, PH. D.

In the following pages it is proposed to make some statements regarding the relation of neurology to psychology as viewed from the standpoint of the former, and also to give a résumé of some rather recent neurological investigations.

Anatomical results have a reputation for superior credibility, and it is a generally accepted idea that within the limits of gross anatomy this reputation is well grounded; but when we glance at the work in minute anatomy or histology, it seems as though a long time must elapse before this latter would be thus honored. The field is clearing, however, and many existing contradictions are rather apparent than real.

As the result of a long discussion in his last paper, v.Gudden(1) nevertheless reaches the conclusion: "First of all let us have anatomy, or if physiology must come first, then never without anatomical control." In the

study of the form and functions of the nervous system there is reason, then, for accepting the anatomical data—though they are far from perfect—as the norm, and for measuring physiological results by them. It follows from this that the more accurate the standard the surer the progress.

The anatomy of the central nervous system is to-day largely topographical. The units are groups of cells and bundles of fibres, and the question to be answered is, as a rule, how these are united. The methods employed to determine the correlation of function with form are the association of the failure of some function with the failure of some part, or the development of the function with the development of the part. At the outset this investigation is balked both from the clinical and experimental sides by those cases where loss of nervous substance is not apparently associated with any or with a corresponding functional disturbance; but these cases, anomalous as they at first appear, will without doubt become clear under proper anatomical investigation, coupled, as it must be, with a much finer analysis of function than is now in use. It is in this direction that much is to be hoped from the improvement of psycho-physical methods.

Leaving those experiments which have localization as their aim, there arises a further question. Given a group of cells with a definite function, what is the fundamental difference between this group and others with a different function? This leads to the much less worked, and as yet less fruitful, field in neurology—the characteristics of the cell itself.

The first steps here are the study of the form and chemistry of the cell. We need not stop at this point, however, but at once go on to ask how far we may

reasonably hope to carry this investigation—to inquire what aid psychology is to expect from neurology in ultimate analysis, and whether it will ever come to pass that from the morphological characteristics of the cell its function can be inferred. It must be admitted that thus far the attempts to infer even from the general form of the brain to the grade of intelligence have failed, and yet that appears to be one of the least difficult questions that wait for an answer. It may therefore be asked whether, without the hope of being able to solve any world-riddle, with failures in correlation in full view, is it worth while to pursue neurology as an aid to psychology? An answer based on the following facts may be given in the affirmative. Neurology is the common factor of most of the approaches to psychology. The comparative, the developmental, the anthropological, the morbid, and the experimental methods all have it as a point of departure, and it may fairly be assumed that further anatomical knowledge will give us an insight into the working of the central nervous system far deeper than that which we now possess; that we may learn to associate certain cell changes with the exhibition of certain functions, and that at present we have no reason to fix a limit beyond which the method may not be carried. Accurate neural anatomy must therefore go hand in hand with accurate psychological analysis.

An account of some recent observations in this field, though fragmentary, may serve to illustrate the tendency of investigation in it. The contributions come from various sources. The anatomists, the physiologists, the psychiatrists, and the morphologists are all concerned. The physiological work has thus far been crippled by the lack of anatomical control; the pro-

fessed anatomists and morphologists have but partially specialized in this direction, so that most of the detailed studies have come from the psychiatrists, men who have other engrossing calls on their time, and whose anatomical work must therefore suffer from discontinuity.

The studies on the physiology of the frog's brain by Steiner,(2) of Heidelberg, which appeared in 1885, mark a distinct advance in the physiological methods. They are careful and accurate, and he sharply distinguishes between facts and theories. The chief technical aim of this investigator was the highest experimental accuracy and the reduction of the non-conforming cases to zero. In this he has succeeded admirably. A similar series of observations on fish,(3) some preliminary account of which has already been published, will probably appear soon. Through these results it is evident that the idea of the development of function has gotten a hold on physiological work. A mammal can be kept alive but a short time without its cerebral hemispheres, while Steiner has shown that the fore brain can be removed from a bony fish and yet the latter moves about and feeds in apparently a normal manner. It is to be remembered that in the teleosts the mantle of the fore brain is a non-nervous sac. Is it to be concluded from this that in the bony fish the voluntary control is seated in some part of the brain other than the cerebral hemispheres, or that we have in these fish an animal that is mainly reflex, with a grain of voluntary control? Both ideas are probably correct. Reflex and voluntary centres have differentiated out of more generalized nervous matter, and as this fish has no functionally developed organ corresponding to the usual seat of the voluntary impulses,

it is conceivable that the lower centres of the brain which are alone functional have a more generalized activity, and that they may be the seat of the imperfect voluntary impulses which appear to exist in this animal. So that, looked at from one point of view, the animal is mainly reflex, that is, the voluntary impulses are quite subordinate, while looked at from the other point, such voluntary impulses as it does possess have their seat in sub-cerebral centres. We have, then, in the development of the nervous system in the animal series, not an evolution in the sense of Bonnet and the older naturalists, namely, differences of bulk, proportions remaining the same; but all through there is a most marked alteration in the relative development and physiological value of the different parts. It is an idea as old as Aristotle, that animals possess but one adequate means of defense, or, to put it more generally, have but one apparatus for doing a given thing. The activities of an animal are partly reflex and partly voluntary, but the proportions vary in each case. In passing from a fish to man we are struck by the increase in the voluntary control, and, according to the principle above stated, we should expect—what we find—a most notable decrease in reflex development. If that were not the case we should have in man the nervous system differentiated along two lines, that is, a double apparatus for the same thing, which approaches the impossible. This idea has its application to the recent work on localization. Without the visual centres in the cortex a man cannot see at all; a dog can perhaps see a trifle, a rabbit more, and so on. This fact receives its explanation in that, the more the functions are pushed into the cortex, the more the lower centres become dependent

on it for their very existence, so that removal of the cortex is followed by the degeneration of these lower centres in man and the higher mammals, while, as we descend the animal series, these centres become less and less dependent on the cortex and better able to act alone, as in the frog and fish. Thus the ability to use the lower centres of vision alone appears inverse to the cortical development.

A justifiable complaint is made against the lack of anatomical control in the majority of the physiological experiments. This is due to the practical difficulties in making such a control, which are plain to any one who knows what control means. The matter has been of late slightly improved, both Munk and Goltz having turned over the brains of carefully observed animals to anatomists. But this at best is the sporadic exhibition of a virtue which should be systematic. It is in a high degree naïve for an operator to maintain that a given animal kept alive after operation has suffered a loss of brain substance which is fully represented by what was removed at the operation, and then to make this assumption the basis for further inference. In every case the secondary degenerations must be considered, and the laws of secondary degeneration from the cortex are not yet well enough known to permit in most cases a reliable inference from the injury alone. Even the brains of dogs operated on by Munk, where the operation is precise and elegant in the highest degree, show changes which can only be made out from sections.

To turn to the anatomical side. It is from the method of v. Gudden that the most is to be hoped at present, or it would be, perhaps, better to define it as the "experimental-anatomical method," for, strictly speak-

ing, that of v. Gudden implies the use of new-born or very young animals, and the results thus obtained differ somewhat from those gotten by experiment on adults. The gist of this method is the artificial development of atrophies. But the very means which is here used to unravel the course of the fibres in the centres is itself a legitimate object for experimentation. Far too little is known of the real significance of degeneration to make it a perfectly safe means by which to study other problems.

While speaking of methods we may mention that of Flechsig, or the method of tracing fibre bundles by the development of their medullary sheaths. The assumptions on which this proceeds are that the fibres forming a bundle physiologically distinct assume their medullary sheaths at one time, and that the fibres surrounding them, but physiologically different, do not get their sheaths at the same time. These assumptions are, however, largely open to investigation, and it would increase confidence in the results thus obtained if the details of the process were more clearly known.

As to anatomical results, those of v. Monakow[(4)] are specially important, from the care and deliberation which characterize the work. In rabbits he has demonstrated the representation of the cortex in the optic thalamus. When a portion of cortex is removed, a part of the thalamic ganglia atrophies, and the relation is a fixed one. So far as tested, similar relations hold for man also. The idea of such a representation had earlier been put forward by Luys, but without any experimental proof. This demonstration is very suggestive, for not only have we the notion of the representation of the cortex in the optic thalamus, but, as cells in the latter atrophy on the removal of the

cortex, they cannot, in mammals as low as rabbits, functionate alone, and must be regarded as intimately associated with the cortex.

General notions of much value have come from Gaskell's[5] attempt to bring the sympathetic system into line, and the introduction of some order and method into that portion of the nervous system has been a very solid contribution. At the same time the spinal ganglia, and those along the cerebral nerves and in the sympathetic, are still riddles, and while they remain without explanation, it may seem a trifle overhasty to rush on to the anatomy of such complicated structures as the brain and cord. No one doubts the value of comparative anatomy for this work, but it might be wise to extend the comparison line into the invertebrates. Dominated by the medical idea that the study of these things rapidly decreases in value as we pass from man downwards, and having a more or less defined feeling that the invertebrates were intended by Providence for the use of the morphologists alone, neurologists have until recently neglected this division; yet it is in the arthropoda that the widest divergence in sense development among nearly related forms is to be found, correlated with differences in the supraoesophageal ganglia. This ganglion, in some ants, has a cortex, and in so far deserves to rank as a brain.

To those acquainted with histological literature the work of Golgi[6] is probably familiar. The essential point of his technical method is the staining of nerve cells with silver nitrate or mercuric chloride, while the surrounding substance remains unstained. The cell and its prolongations thus stand out like a silhouette. The cell structure is unfortunately lost by this treatment, but the prolongations are beautifully exhibited.

The notion of cell prolongations and their significance, previous to Golgi, may be stated as follows: These cells were considered to have one unbranched prolongation, the axis-cylinder process, which continued itself into a nerve fibre. The other, the so-called protoplasmic processes, were branched and were thought to anastomose. Golgi's preparations show first that the axis cylinder, which is wonderfully demonstrated, is always branched, and second, that the protoplasmic processes do not anastomose. Since they generally trend toward bloodvessels, Golgi looks upon them as nutritive arms.

To return to the axis-cylinder processes: These are not all alike. Two types are recognized, and the typical forms are perfectly distinct. The first is that in which the axis cylinder, maintaining its identity, gives off fine lateral branches. The second is that in which the branching is profuse and rapid and in a short space the identity of the axis cylinder is lost in a network. Cells of these types are found separated in the different parts of the brain. On examining the spinal cord it is found that the cells in the anterior cornua belong to the first type, while those in the posterior belong to the second. It was this observation which led Golgi to develop the theory that the cells of the first type were motor and those of the second sensory in function. For the moment accepting this view, there still remains to be explained the meaning of the branches from the axis cylinder and the manner in which the cells of the second type are joined with the periphery. Golgi thinks that it must be through the anastomoses of the branches from the axis cylinder that the several cells are put into communication with one another. All the branches from the axis cylinders

of the first type are thus used, but only a part of those of the second. When an entering fibre loses its medullary sheath it becomes essentially an axis cylinder, and by this method stains as such, so that fibres in this condition can be followed in the neighborhood of the cells. In the posterior cornua of the cord there are fibres which thus enter and break up into a network analogous to that of the axis cylinder of the cells of the second type. It is supposed that this network is in connection with the network of the cells, and that at this point the isolated conduction ceases and the fibre is connected not with one cell but with a group. According to this idea we have to deal with groups of cells instead of single ones, and the explaining power of such a view is considerable. It would have been scarcely worth while to dwell on these observations of Golgi if they were questionable. So far as his facts and plates go they are perfectly reliable, and he understands as clearly as others where the facts leave off and speculation commences. These results have gotten into our literature only somewhat recently, and in order to show that the ideas have not grown up in a night, it may be mentioned that Golgi's first investigation with this method was published in 1874, and from that time up to 1886 he has been more or less occupied in these researches.

This method is selective. Not all the cells are stained; in fact, as a rule, only a small proportion is affected. If now the reaction is a chemical one, it is to be inferred that those cells which stain are in a peculiar chemical condition, and this suggests that changes in the nutritive state of brain might alter the manner in which it is stained.

In this connection at least a reference should be made to the modifications of the above method by

Mondino, a pupil of Golgi. He found that if sufficient time was allowed, whole human brains could be stained throughout by mercuric chloride. It is claimed that this will give a means of following out cell connections equal to any now used, but thus far it has not been put to the test.

It was necessary to wait until something had been said of the experimental method in anatomy and of Golgi's results before referring to the conclusions of Forel,(7) which involve both. Making use of two guinea pigs, he removed the facial nerve in one by pulling it out at the point where it emerges from the base of the brain, and in the other where it emerges from the skull he sectioned it. In the first animal the nucleus atrophied completely ; in the second there was some atrophy, but many cells and fibres were simply shrunken, the difference between the two nerves and nuclei in the two animals being very marked. His conclusion from this is that the cell and its fibre considered as one organism can, like any other individual, lose a part of itself without being killed or seriously disabled, but as the relative size of the part removed becomes greater, the injury to the remaining part becomes more marked, until finally, if enough be removed, the remainder will die. According to this view, when the facialis has been separated at the base of the brain, enough has been removed to kill the remaining part, but when it is separated at the point of emergence from the skull, the part removed is sufficient to cause only a severe disturbance in the fibres and cells, and not their death. As is plain, this is rather a suggestion than an explanation ; but it is a valuable one. Here is an attempt to give some meaning to the "nutritive centre" theory and the notions of degeneration involved in it.

To return for a moment to the fibres ending in a network, which Golgi finds in the posterior cornua of the cord. Most probably, according to Forel, these fibres arise from peripheral cells, and the network represents the termination in the cord of a fibre which has travelled from a peripheral cell through the posterior roots to the cord. But this is analogous to the cell of the first type, which sends the main stem of its axis-cylinder process directly by a fibre to a muscle, there to end in a network. The picture that we have then, in its simplest form, is that of a central or motor cell sending its axis cylinder toward the periphery and there forming a network, while the peripheral sensory cell sends its axis cylinder toward the centre and there likewise forms a network. Both sensory and motor cells are then of Golgi's first type. But there are still the cells of the second type left over—cells which may be conceived of as modified from the first by the excessive shortening of that part of the axis cylinder which would represent the nerve, thus bringing the terminal network close to the body of the cell. These need to be accounted for. If Forel's idea is correct they are to be designated as central cells, the function being indeterminate. Their relation to the fibres is further borne out by the way they react when the nerve is sectioned. It is known that the disturbance caused in a nucleus by the removal of a sensory nerve differs from that following the removal of a motor nerve. In the former case it is rather a shrinking than a true degeneration of the cells which occurs. This is somewhat explained by supposing the connection with the fibres to be that assumed by Golgi and Forel, or at least by supposing the manner of connection in the two cases to be different. Objections are not wanting

to these views, but at the same time they are supported by the recent observations of His[8] on the human embryo, where the developing sensory cells in the spinal ganglia send their processes in toward the centre.

The above summarizes, in a way confessedly incomplete, certain recent advances in neurology, with a view to indicating what the field is and what some of the results are. If the idea be admitted that pyschic activity is conditioned by anatomical structure, then these results have a significance for psychology.

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INSISTENT AND FIXED IDEAS.

BY EDWARD COWLES, M. D.

The student of introspective psychology must assume a standard of cerebral and mental health as the basis of his study. It must be sought in the healthy mind in a healthy brain; these are the inseparable subjects of the inquiry.

The student of insanity must assume, in like manner, the same standard of soundness for that which is insane, and he must study it in the terms of psychology; and the physiological basis is definite enough, if the communications with it are maintained, to permit safe and even bold excursions among the dangers of error that beset the path of the purely intuitional school. With practical reference to such a standard, modern psychiatry has the credit of having differentiated two general groups of idiopathic mental disorders. The first group includes those that may happen to any healthy mind in a healthy brain, and are manifested in typical and regular forms and courses of mental phenomena. The other contains those that occur in unstable minds correlative to constitutional brain defect—hereditary or acquired—and that are manifested in more or less irregular forms in which the phenomena are made distinctive by being modified and varied in their order and degree from those in the first group. The term "ordinary insanity" has been

applied to the disorders that spring from a relatively sound physical basis. The modern use of the term "paranoia" has been gradually enlarged till it tends to include all manifestations of hereditary and acquired chronic instability of mind. Thus there may be "ordinary insanity" in relation to the healthy brain, and "paranoia" in the unstable mind and defective brain. The general relation of these physical and psychical elements may thus be stated in terms of function: as the stable mind is to the unstable one, so are the disorders—psychoses—incident to the former, to the degenerative psychoses in the latter—or so is ordinary insanity to paranoia.

While pathology and psycho-physics are striving to let in the light upon the mechanism of mental phenomena, the clinical student must not wait for their guidance. His work is as essential to the elucidation of the truth, and his data are definite, tangible, and constant enough to endow them with scientific values. The science of psycho-pathology deals directly with the central object itself; the mind is the man, and the conservation of mental integrity is the aim. In the minute study of the psychical elements involved the clinical student has in his field as important a branch of the new psychology as the pathologist or the psycho-physicist; all must work together in the solution of the problems.

The recent words of Sir James Paget, upon another subject, are as applicable here, that the sick-room is a laboratory with its crucial experiments as real as those in which "culture experiments" are instituted in bacteriology. Kraepelin, speaking of natural science as the great method in medicine, says that "only by the inner connection of brain pathology with psycho-

pathology can we succeed in finding the laws of the reciprocal relation between somatic and psychic disturbance, and thus get to a really deeper understanding of the phenomena of insanity."[1] Sir J. Crichton Browne strongly stated, in 1878, the absurdity of resting upon an intimate knowledge of brain-cells, or of the deviations from healthy mental states in which insanity consists. Advancement must be made on both these lines, which must converge and unite. "But," he also says, "in that particular branch of psychology that is conversant with morbid mental states, little or no work is being done in Great Britain. In the literature of insanity of to-day there is no attempt at mental analysis, and only a most perfunctory attempt at a classification of the expressions and products of the diseased mind."[2] Exner also, in his remarkable study of cerebral localization, found reason to complain of the inadequacy with which clinical symptoms are described in asylum reports.[3]

To a better purpose is Kandinsky's very full and exceptionally fine study of three cases of hallucinations. He says: "What is wanted, first of all, is a severe, accurate and detailed study of the phenomena of hallucinations, and but very few (three by Sander and one by Pick) have been studied with sufficient care.[4] In modern psychiatry there is an evident tendency to return to the study of psychical phenomena and to break away somewhat from the dicta of the cerebralists. Insanity, in its origin at least, may be

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[1] Kraepelin, *Compendium der Psychiatrie*, 1883, p. 3.

[2] Presidential Address, British Medico-Psychological Association, *Journal of Mental Science*, Oct., 1878.

[3] Exner, *Localisation der Functionen*, 1881, *passim*.

[4] Kandinsky, *Kritische und Klinische Betrachtungen*, 1885, p. 2 *et seq.*

as much a matter of disorder of the mind as of disease of the brain.[1]

Accepting the proposition that every manifestation of mind is correlated to a definite mode and sphere of brain activity, and the aim being a convention of the two lines of study, the indications are plain to the alienist. Psycho-pathology demands, upon one of these lines, careful and detailed analyses of morbid psychical reactions. This article is an attempt to comply with that demand.

From the clinical point of view the student finds himself in a region of ever-widening interest and novelty, for so much of it is unexplored. In examining these products, some salient or eccentric growth brings to light or emphasizes common factors of the whole that would otherwise remain obscure. The infinite variety of the human mind is in nowise more plainly revealed than in its aberrations. In the whole range of its special powers or qualities they may become, singly or in groups, more conspicuous by their relative luxuriance or exaggeration, or by their absence or weakness and impairment. In the broad borderland of minor and partial aberrations there is an instructive field for study. At the points of departure from the normal states of mind is to be sought the genesis of mental disorders, and their nature is shown by the study of their origins. The nature also of the normal faculties themselves may be thus made clearer.

A most fertile source of such knowledge is to be found in that great group of limited disorders of ideation called "fixed ideas." In the understanding of these affections a great advance has been made within the last few years. They have been studied,

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[1] Cf. Savage, *Insanity*, 1884, pp. 4, 21.

especially by the Germans, French, and Italians, during the last thirty years, and many names given to different varieties, but it remained for Tamburini[1] to show the common relation of these affections under the term *Zwangsvorstellungen*, first applied by Krafft-Ebing. They include the "metaphysical insanity," "insanity of doubting," and the many forms of "fears" of places and things.

Kandinsky mentions the difficulties of getting the intelligent co-operation of patients in his studies of hallucinations. The importance of the study of "imperative conceptions" is as great; and while its profit may be relatively much greater as touching earlier stages or less degrees of aberration, in these cases also the comparative integrity of the intelligence, except as specially involved, is a great aid. It is curiously possible to enucleate, as it were, certain well defined ideas and feelings, and to study their reactions between each other and the will.

The general characteristics of "the cases yet described" are thus briefly stated by Tamburini: "1st. That side by side with a fixed idea which is accompanied by fears more or less distressing, and an overpowering impulsion to certain acts, consciousness of the absurdity of such acts usually remains complete. 2d. That in all there is an almost absolute impotence of the will, not only to control the absurd ideas, but also an irrestrainable tendency to those acts. 3d. That in almost all the cases there was a very conspicuous hereditary predisposition to psychopathic disorders."

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[1] *Revista Sperimentale di Freniatria*, Fascicolo 1, 1883. Translated by Joseph Workman, M. D., Alienist and Neurologist, January, 1884.

A varied collection of cases of these affections has afforded the writer a study of great interest for a number of years. In these cases the relation seems to be clearly shown of these limited ideational disorders to primary delusional insanity, as indicated by Westphal's designation of them as "abortive monomania." Not only this, but in my observations there appears to be ample evidence that there may be every degree of development of these disorders, from the slightest departure from normal intellection to pronounced delusional conceptions. Also, that instead of passing in the typical way from stage to stage, the process may be arrested at any point in its progress and remain at a chronic stasis during the remainder of a lifetime. There is a multitude of the cases of the minor degree which, as far as they go, have all the essential characteristics of "fixed ideas," but in which the "idea" is not so "fixed" as to be always dominant; it can be resisted more or less successfully at will, in the milder cases, which are in a large majority. The ideas are simply insistent, and the term "insistent ideas" is here proposed as being the more generic, and as including all forms, some of which become "imperative" and "fixed." Here the words "idea" and "fixed idea" are distinctive, in contrast with "delusion" or "fixed and limited delusion." The one is not a belief, while the other has attained the pronounced degree of an insane belief.

Again, contrary to the conclusions of writers on the subject, it would appear that these affections are not "chiefly limited to a constitutional origin, especially to heredity." Here arises one of the most interesting questions. Primary systematized delusions so characterize paranoia, and so close is the relation

between them and fixed ideas or imperative conceptions, that these also are included in paranoia by many writers, with the implication that these affections always signify a constitutional origin in either acquired or hereditary defect. But degenerative psychoses are not manifestations of new powers acquired by morbidity in the organism: there is not more mind in the paranoiac brain. The criterion of insanity is not essentially the formulation of incongruous, "insane" conceptions — this is common enough in the sane mind and healthy brain,—witness dreams, the play of the imagination, etc. The inability to correct some of these, or to inhibit others, constitutes the insanity. Of imperative conceptions we should expect, *a priori*, to find that the conceptions are common enough to sound minds. But where, in the scale of increasing insistence, fixedness, or imperativeness, does evidence begin of their having a paranoiac basis of hereditary or acquired defect and mental instability? So, too, of systematized delusions; if but rare in a sound mind, this is enough to establish the premise.

Proper conservation demands at least a stay of inferences and implications in this matter. It might be expected to be nearer the truth to say that insistent and fixed ideas, especially in their milder and often "corrected" forms, are common to healthy minds and brains, or to those which have no more "acquired instability" or neurasthenia than would be argued as existing in a melancholia or mania of an ordinary insanity. As forming a symptom group of ideational disorders in the prodromal or abortive stages of ordinary insanity, they become, like delusions, emphasized in paranoia. Thus these affections being once

initiated, the gravest forms are simply more likely to be developed upon a basis of neurasthenia or the more radical paranoiac conditions; in other words, when there is hereditary or acquired nervous and mental instability.

In regard to other views that have been held of these affections, it does not seem necessary to delve deeply into the mysteries of "the inconscient" for an explanation of all these anomalies. Again, the common kinship of the recognized varieties of these affections, as shown by Tamburini, is finely demonstrated in a number of my cases, in which there have been developed, in succession in each individual case, several of the distinct forms. These transitions are not unusual, and it is probable that some of the forms now recognized as distinct, if it were possible to trace them to their origin, would be found to be secondary to the more common primitive ones.

It is not the present intention to attempt a demonstration of these propositions, which are thus broadly stated for the sake of indicating the nature and the interest of the questions that arise in these investigations. The limits of this article permit simply a detailed account of a case in which there is much to sustain the foregoing propositions. The unusual intelligence of the patient allowed a long series of mental phenomena, occupying years, to be traced even from their origin. At the outset the case was a common one of the "insanity of doubting," in which the idea was that simple acts were not right and it was necessary to repeat them to make them so. The complications that followed, and the stages of the malady through which the patient passed, came partly by logical evolution from the false premises, and partly from the growth of

a habit of methodizing thought and action; the latter was a characteristic process of circumvention of the limited imperative conception, against which the will was powerless for direct resistance. The processes of evasion were invented and systematized by a keen intelligence, and carried out by an otherwise efficient will, to the effect of accomplishing the desired purposes without directly antagonizing the fixed ideas. An interesting feature of the case is the unique combination of the characteristic "fear" of the patient for herself, with a "fear" in behalf of, and a "jealousy" against, another person, for whom she had both "love" and "admiration." The interplay and complication of these feelings are illustrations also of the probable fact that the abnormal association of "ideas" and their accompanying "feelings" may commonly enough involve in like manner other feelings than the "fears" of which so many varieties are named. This case with its extended details is here presented as a preliminary study of the subject. The medical "reporting" of such a personal history is justified by the proffered permission of this lady and by other proper consent.

Miss M. came under my care as an asylum patient at the age of 28 years. She was of a good family in heredity and otherwise; and both the parents were then living, and over 70 years of age. She was the youngest of ten children, all of whom had been healthy except two sisters who died of phthisis after marriage. The patient had a good physique, was a little above the average stature, and in good bodily health in all particulars. She soon established herself, in a company of lady patients of the better or convalescent class, as a person of more than ordinary intelligence

and good sense, and as usually amiable, pleasing and dignified in manner; though reticent, she was not unsocial. She was disposed, however, to dress very plainly and to be negligent in this regard, in a way that was inconsistent with her evident appreciation of what was pleasing and proper. Her intellect was, to ordinary observation, apparently unimpaired, and for a period of more than two years she revealed her morbid mental peculiarities to none but two of her physicians. She was well informed, read good books, chose the most intelligent persons as companions, could easily follow and take part in a psychological analysis of her own case, was keen of insight and quick at repartee. She was depressed at times and inclined to seclude herself in her room, and later she was sometimes irritable and sarcastic toward her associates; but in general she was known to them only as possessing the creditable characteristics above described. In brief, she was in many respects an interesting person.

To her physicians, however, she presented a medley of curious and inconsistent symptoms. She was admitted to the asylum as a case of suicidal melancholia, but as a "voluntary patient" (without a regular examination and commitment as an insane person). The immediate cause of her coming was a suicidal act. It is of special interest and importance in the diagnosis of some cases of primary disorders of intellection to differentiate them from those of the feelings characterizing true melancholia; this case strikingly illustrates the relation and contrast between these two forms of mental disease. To make this plain it is necessary to give an outline of this patient's history as it was received on her admission, and the earlier observations of the case before its riddle was solved.

There was no known neurotic heredity in the family history. She had always been physically strong and healthy, and never employed a physician. At about the age of nineteen years she first attracted attention to her mental disorder by secluding herself and refusing to see her friends. At about the age of twenty-five years her relatives became fully impressed that her condition was morbid and serious. She excluded them from her room, was difficult to manage, and spent her time in slovenly indolence.

Four months before becoming my patient she was brought to a neighboring institution for the treatment of nervous diseases. It was said that while there she was shy and silent, exercised no care of her clothing or person, neither working nor reading, lying on the bed if not watched, and all efforts to interest her in anything were failures. At times she was much agitated and felt that she was "going crazy" and said, "my proper place is in an insane asylum." She gradually became more depressed and suspicious, and entertained delusions of a gloomy character, of her own wickedness in relation to indiscretions of her early years, and of great wrong-doing. It was stated that "she developed the delusion that all who have anything to do with her would suffer injury or death; and that she made vows not to do certain things, and entertained the delusion that by breaking them she brought trouble, perhaps death, on a friend of hers." Finally, she got access to a bottle of laudanum and took "three or four teaspoonfuls," apparently with suicidal intent. "She manifested no remorse, but sorrow for her failure. When remonstrated with was sullen, and threatened to do it again at the first opportunity."

Two days afterward she was brought to the asylum.

Her intelligence, reasonableness and self-possession led to her being placed at once with the convalescent patients; and her manifest satisfaction with the change was significant in the light of later revelations. Her general demeanor was as has been described, but she was carefully watched, never allowed to seclude herself, and by night as well as by day the door of her room was kept partly open. There were signs of mental depression at times, and she was very reticent at first; but soon she began to repeat to her physicians the self-accusation before mentioned, and later told a story of having attempted homicidal acts, and alluded to other events of her history which she regarded as evidences of depravity and loss of conscience; this was not consistent with her daily, lady-like conduct. She spoke of herself as being insane, but at last discovered that she was unlike other patients who had melancholia. Indeed, the notable absence of the characteristic, underlying depression of feelings piqued inquiry. Her keenness of intellect and bright-witted though respectful rejection of the customary comforting assurances of possible recovery were entertaining as well as baffling. The assemblage of symptoms seemed anomalous. She at length said to me, "I have a monomania," and gave me more fully than before a curious, puzzling account of a long-existing fear that her ordinary acts might do harm to a lady friend whom she had always loved and admired, and whom she said she had once maliciously attempted to injure; and she manifested genuine grief about it. She readily understood and gladly accepted the explanation of the absurdity of these and other ideas, and tried to act upon this view of them. The characteristic qualities of a delusion appeared to be absent, and the depres-

sion to be secondary, or, as Krafft-Ebing says, "proceeding from the sad consciousness of the formal disorder of ideation—almost always painful and sometimes dangerous."

Soon after admission she began to insist that her previous suicidal act was not done with that intent, but gave a halting explanation of it. She finally overcame her reticence enough to give an intelligible and undoubtedly truthful account of the affair and its motive, essentially as follows: It appears that her intense pride had for years kept her from revealing the secret of her mental troubles; and the only exception to this was an intimation to her mother on one occasion. It was a new experience to have a sympathizing physician, and it became a source of comfort to her. Into her self-inquisition there finally came the idea of some impropriety, on her part, in finding the physician's visits to be agreeable; and upon this as a basis of self-accusation she finally determined to escape from the perfectly proper relation of which she morbidly thought herself ashamed. She thought she ought to be placed among the insane, and so conceived the plan of feigning the suicidal act, suggested by the opportunity that offered itself. She purposely limited the dose of laudanum to "a moderate quantity, and chose a time when its effect would be discovered in season to prevent serious consequences." She thought she would be sent to an asylum, and so conducted herself after the event as to insure this result. All this being regarded as evidence of absence of true suicidal feeling and motive, it formed an important factor in determining the subsequent treatment of the case as not being one of true melancholia.

She gave vague and partial accounts of many years

of mental pain, declared her hopelessness of recovery, and that death offered the only possible relief. Looking significantly about her room for points of suspension, she would say to me that she could not do it here, but if it were possible she would end her troubles. The consequent surveillance became annoying to her, and she begged to have her chamber door closed at night. When asked to promise that she would not attempt self-injury, she acknowledged the rightfulness of the request, but said, "You cannot trust me, my pledge is worth nothing; I have no conscience, and cannot trust myself; my life is ruined, and I justify myself in always gratifying my wicked desires regardless of right or wrong." She was told that she was mistaken, that she showed more than ordinary keenness of conscience, and that it was only a morbid sensitiveness of it that prompted unjust and undeserved self-reproach; that her sense of honor was so strong that I knew she could not betray my confidence, that she would be trusted, and must make the promise. The promise was made, her door closed at night, and the watching largely abated.

New information now received from her relatives gave an interesting insight into her real character. She was described by her teacher, when at the age of ten or eleven years, as the brightest of a large class of girls, and remarkably conscientious, once refusing to wear a medal awarded to her, for the reason that she thought the honor belonged to another. "She was the most truthful child" the teacher "ever knew, the life of the school, intelligent, high-spirited, and beloved." She maintained these characteristics until the age of twenty-five years. She was, as a school girl, mentally superior to her associates, and distin-

guished for her truthfulness and unselfishness. Though naturally reticent as to her personal feelings, she was bright and companionable, esteemed and admired by her friends. This corroborates the estimate made of her even under the adverse conditions of an asylum.

All went well with her for several months under the enforced parole. She grew more cheerful, and less reticent as to the details of her previous history. Then one more incident occurred which is of interest, in the aspect of the case now under consideration, as to the significance of its bearing upon the question of melancholia. Five months after her admission, a suicidal accident happened in another part of the house, in my absence; my assistants were naturally anxious. Just then this patient made, to one of them, a remark, the subject of which, when occasionally mentioned to me, had been treated as tabooed—that is, the allusion to suicide, and that she thought there was "no way here." The revival of close watching was a natural consequence, and her offered promise "not to attempt it here" was not understood or accepted.

Aggrieved by this she made one of her self-imposed vows, which will be hereafter described as characteristic, that she would never make another promise. Upon an appeal to me, she agreed to the soundness and justice of the position that there should rightly be the guaranty of her pledge before the restoration of her privileges. She begged that the promise should be waived, for, she said, "You know how dreadfully I shall suffer if I break my vow, but if you insist, I must do it." With my practical belief in the true nature of her malady, she was told after some days of "considering" it, and setting forth my responsibility, that the nurse would be at once directed to restore her

former privileges as if she had again given her parole; but that if she accepted my renewed confidence, and still had it in her heart to betray it in any way, she had no right to let me commit myself to such a course. The reply was simply, "You are right, Doctor!" Her appreciation of this proof of confidence was such that from this time forth there was no more reticence with me, but she asked that none of her associates or nurses should know her secret. The subject of suicide was practically dropped. The analysis now to be given of the mental phenomena of the case was worked out, and our relations remained upon this trustful basis for two years. She became more cheerful, and even hopeful. By dint of hours of talking, the earlier and later incidents of her mental history were made clear, and such was her intelligence that it was possible to trace to its origin the train of evolution of her morbid ideation; also to unify, as parts of one process, the strange and apparently incomprehensible events of her life. Their consistency was also shown with a personal character of rare quality, which she was not only unconscious of possessing, but which she felt to be vicious, not as a matter of delusion, but from the intricate complication and confusion of her morbid intellection. Above all it revealed the extent to which, under the domination of a tyrannous, imperative conception, the obscuration of such qualities of character can go, and the pitiful havoc and unspeakable torment that can be created in a mind that remains intelligent and conscious of it all. The interest of the case lies largely in the clearness of the differentiation it was possible to make between the earlier and later ideational elements that made up the psychological enigma. In a characteristic way, the earlier ones either disappeared

or became obscured in the later complications, and it is rare that their growth can be so clearly traced as in this instance. The peculiar details already given are not so trivial as might appear, but are valuable as representative of the mental qualities that are to be studied in this case. The array of symptoms, at first presented, was quite typical of melancholia with suicidal impulse, and such a diagnosis was justifiable; but closer investigation made clear the distinctly ideational character of the disorder as being "the insanity of fixed ideas" in an advanced stage. The plan of management of the case was to instruct the patient with a thorough understanding of the nature of her malady and how to set up a counter habit of motive and conduct; she was urged to take a "new master" —the dictum of her physician as the antagonist of her "fixed idea." The results of her first efforts to do this and of the study of the case will be given in the form of a mental history of the patient. She left my care some time ago, but the narration is given as of the present time.

During her early years, from ten to twelve, she remembers that she was sometimes depressed and had fears of harm, even of death, happening to herself or her relatives, and with no reason for them. The word "trance" became painful to her, because she had heard this and kindred subjects much talked about; so that this word in particular suggested thoughts of herself or friends being buried alive. In her twelfth year she was nervous and ill, and in consequence was taken from school for six months. She vaguely remembers having, during these two years, the fear of harm in connection with doubts as to whether some simple acts were right. She had to repeat some such acts; but she

had become quite well of these morbid experiences before the age of fourteen years. In this year she survived a nearly fatal attack of typhoid fever and was a year or more in recovering from its consequences. It was during this convalescence that, for the first time, she confided to her mother her worries and troubles. It is necessary to make some allowance for her present disposition unduly to reproach herself, but she thinks that at that time there were two prominent features in her character: that she was at times depressed and conscience-smitten, and that she was always of a jealous disposition. She believes she overcame her reticence and revealed her feelings to her mother only because she was sick and weak. The next year, while still not strong, she resumed attendance at school. Being relatively backward, she studied very hard, but led in scholarship. Her daily journey to school was fatiguing, and there were irregularity of meals and study by night. During this year menstruation began. The feelings of hesitation in performing simple acts, like those of three years before, now reappeared. In walking, dressing or undressing, for example, she was obliged to repeat many such actions; she did this, however, only when unobserved, and then could not help it. Here was the genesis of a common form of fixed ideas,—the idea that the act performed is not right, the accompanying vague fear that some harm will follow if it is not made right, and the necessity of repeating the act to make it so. From this point all the rest follows in its morbid train.

One of her schoolmates, a distant relative, was a girl of her own age, called in this history C. She was beautiful in person, lovely in character, and destined to exercise an extraordinary influence upon the after-

life of the patient M. The latter was the intellectual superior, but became jealous, she says, of the attention C. received, although she admired and loved her very much. M. did not manifest this evil feeling in any way, but it gradually developed to one of strong hatred, or one that seemed to be such in her extreme conscientiousness. In connection with this feeling there were evolved thoughts of harmful things that might happen to C., and then of self-condemnation as if she were guilty of desiring them to happen. This seems to have begun in the natural feelings common to all conscientious persons. M. next questioned herself if she would not be tempted to do violence to C. should there be an opportunity. This became mixed with the repetition of her acts; there was first a feeling of vague fear if she did not repeat them; then there came to be associated with the insistent idea a definite feeling of fear of harmful consequences to C. if the morbid impulse of repetition were not obeyed; then for a time this fear was dispelled by compelling herself to repeat the special act a certain number of times, more or less on different occasions. This fear of injuring C. was harmonized with her so-called hatred of her, as it was not so much because of the pain of contemplating possible harm to C. as because of the suffering M. feared would be inflicted upon herself by her offended conscience, if any such harm as she thought of did happen to C. It would be as if her thinking of harm in connection with C. had made it happen to her, and M. were to blame for it. Up to this point the morbid process had advanced through several stages of evolution and complication. M. realized all through this that she would not be even morally responsible perhaps, should such harm happen, but she went on all the same, yield-

ing to the domination of the morbid idea, which her will was powerless to resist, and fearing the self-accusations of her conscience—both the actual and the possible.

After this there came the apprehension that something would happen to C., and M.'s mind became tormented with thoughts of her own probable sufferings from the blame of which she knew her conscience would accuse her. She soon became unable to read, or hear, or think of any painful thing, or of death, as happening to any human being, without feeling and fearing that it might happen and then was about to happen to C., and mentally anticipating her own consequent sufferings. Thus these processes kept her mind full of painful feelings. She found a way to allay them by forcing herself to think of some person known to her, other than C., whom she would mentally substitute for the latter, and whom she would set up in her mind, the moment the morbid idea came, to be the recipient of the imagined or suggested harm. This worked well for a while, but soon began to be refined upon. It became necessary to choose for the substituted person some one with many opposite characteristics to C.; for example, there had to be a difference in age, sometimes of sex, initials of name, color of eyes and hair, stature, distance as to residence from C., and at last peculiar requirements as to time, place, etc., etc., to an endless extent. Next it became necessary to have ready in mind a number of chosen persons, two, or three, or four of whom, as the case might be, must be thought of in a certain order, etc. After a while, thinking of these persons ceased to give mental relief and another set had to be chosen, to wear out in turn. The process was this:—if in reading or in conversation or in any way,

by direct suggestion, or by the law of association of ideas, the thought of personal harm to any one came into her mind, the thought of C. as suffering that harm came also. Before the mental action thus interrupted could proceed she must call up the mentally prepared substitutes and imagine them as possessed of all the prescribed characteristics, and in the certain order, etc., as having the harmful thing thought of inflicted upon them. This imagining relieved her, but at last it became necessary to wish it to happen to them, then by degrees to imprecate it upon them with increasing intensity of oaths and cursing, although it shocked her very much. She became very expert in this process of exorcising the fear the morbid idea would arouse; she could go on directly with the conversation, for example, and keep up appearances. Her pride in this regard, her perfect concealment of this whole matter from every one, was extraordinary and very characteristic of the malady. It was only after six years of suffering, and at the age of twenty-two, that she first revealed something of it to her mother.

The process of relieving her mind of the painful idea when suggested in any way not connected with any acts of her own has been described. On the other hand, in regard to these, the hesitating and repeating impulse also grew upon her, and finally crept into all her acts. It will be remembered that she feared they would cause some harm to C. if not done right. She could at first relieve herself from this state of doubting or hesitating in an act, by exerting indirectly the inhibitory influence of self-control over the morbid repetition impulse, as for example, by intellectually prescribing that she should repeat the partial or full accomplishment of the interrupted act a certain number

of times, more or less on different occasions. As this process became more complicated and difficult to conceal, her intense pride in maintaining appearances led to devices for abbreviation. If she fell into a state of indecision in the attempted doing of any act, and needed to compel action to avoid betrayal of herself, she could succeed by strongly vowing that she would do it, adding the stimulus of harm to C. as the self-imprecated penalty of failure; of course, this involved all the dreadful consequences to herself. To reinforce this process, also, vowing became swearing, and then came the necessity of the most fearful and blasphemous imprecations upon herself, to compel herself to do or not to do certain acts, then or thereafter, upon pain of inflicting injury upon her friend, and of all its dreadful consequences upon herself. All this was sufficiently complicated, but she regards these things as primary in the sequences of complication and mental entanglement that were afterwards evolved. These two things, however, have run through all the phases of the fifteen years' existence of the malady: "the binding of herself over," as she says, by vows and oaths in a complicated system of methodizing all her acts, and the process of substituting vicarious sufferers of every harmful thing thought of, in order to shield her friend, and secondarily herself, from the consequences of imaginary harm to her friend. There was self-accusation, however, just as if she had maliciously wished the harm upon her friend. But all this was her secret. There was indeed a skeleton in her mental closet, animated by the Satanic double of her own mind, that tyrannized over her conscience and thoughts with a world of intricate formulae of thinking and doing. She says she has lived two lives.

The conditions so far described were quite fully developed when she was eighteen years of age. She had become unable to study, and then left school; for two years she led a listless, aimless life, she says, with loss of her natural inclination for reading, acquiring accomplishments, etc. She maintained her social relations in every way, however, and was sufficiently cheerful and spirited in manner, except with members of her own family. New complications were then evolved. She began to be compelled to give up her dearest friends. An innocent remark made by one of them might suggest the painful association of ideas in M.'s mind; or she might meet at a friend's house some person against whom she had acquired an aversion through her morbid idea. To be rid of the distress the painful memory would cause on meeting her friend, or visiting her house again, she must be rid of such friends; thus, one by one, she had to avoid them. Otherwise, also, the morbid idea brought in its train many others, and these brought another set, and so on in a wide-spreading combination, the outcome of which would finally narrow down to imaginary harm to C. If M. tolerated her friend any longer, and thus necessarily all the bad company of harmful ideas, she felt that she became a party to the combination, and thus subject to blame by her conscience under the compulsion of the tyrannizing idea.

The obstructive influence of the morbid association of ideas interfered with all the minor acts of her daily life. It affected the taking of certain articles of food, or going to certain places; interdicted certain things, or permitted them on certain days and not on others. Colors, pictures and ornaments were banished from her room. She was fond of dress, but certain materials

and many colors could not be worn, although she most liked them. Certain days were tabooed for shopping, because they were anniversaries of painful events in her morbid calendar; and certain shops could not be entered. When the new dress was obtained, very likely it could not be worn because of some newly imagined danger of potential harm to her friend. Thus it became more and more difficult to keep up appearances among her well-dressed associates; and retaining all of her pride in this regard, she began to seclude herself. Later, this led to the neglectful personal habits before described. Acts relating to all these things were complicated or prevented by her vow. She would not reveal her troubles to her friends —in fact, was ashamed and afraid to do so.

Finally, her relatives were made anxious by her peculiarities, and after a scene she submitted to the visit of a physician, who was told something of her physical condition. She was taken away to the country and greatly improved in a short time. But while there she heard of the death of a young neighbor, whom she had mentally used in the substitution process of wishing he might die to save her friend. This was a great shock to her, and she says that if she had deliberately killed the young man she could not have felt worse. For a year after that her condition was distressing; she secluded herself, became despondent and irritable. A new phase of her mental condition now developed, and there was a reaction from the unquestioning submission to her compulsive idea, and the growth of the feeling of resentful desperation. When about twenty years old she was again taken away to the country, and without any warning, "as if the fates had willed it," she was

taken to visit at the home of her friend, C., where she spent three months. It was a dreadful experience; she felt that she must and did keep up appearances. All her former admiration of her friend's character and beauty revived, but with it of course came the antagonizing jealousy, and these opposing feelings went on together. Her friend was lovely, fortunate and happy; she felt herself to be the contrary, and managed to evolve the notion that her friend was somehow to blame for her own sufferings. But again, a pleasant conversation would dispel the evil feelings, and she would wonder how such terrible things could exist in her mind. She does not know how the thought of injuring her friend arose, but the habit of mental vacillation between doing and not doing took up the thought and made her miserable. She knew the place where a razor was kept. She condemns herself unsparingly for all that followed, but she sometimes thinks that she became involved in a mental obligation to put herself to the test of going as far as possible with the act of killing C. and stopping just short of really wounding her. One day, in a room that suited the purpose, she approached C. from behind and drew the razor close across her throat, greatly frightening her; but M. succeeded in laughing it off as a joke. After this there was, of course, new and real cause for self-reproach, and the feeling took possession of her that she was at heart a murderess, and that this was the result of her former wicked self-indulgence. Finally, after a year of this worry, she was forced to get a young friend to spend the night with her before whose throat, when asleep, she drew a razor. This cancelled, as it were, the former act.

She spent the three years following the age of twenty with friends in various places, being unwilling to

return home. Matters secretly went from bad to worse with her, and the hope of some outlet from her mental troubles grew less, but she preserved appearances fairly well. It was during this period that she made to her mother the partial confession already mentioned. A sister died, about whom she suffered great remorse because of some unkindness shown her a few years before, and she confessed her feelings to an older sister. This did her some good, but soon all was as before. During the next two years she gave up her social relations more and more, ceased attending church, making calls, etc., finally saw only two or three friends.

During these five years a number of the persons died whom she had used in the process of mental substitution for C.; this cut her off from her associations, if she had any, with the families of those persons, besides causing an increase of her unhappy feelings. She did some reading, was sometimes taken to places of amusement, and could laugh and be companionable, but this was always hard. She often wished that she might die, but the idea of suicide never suggested itself, except to excite wonder, quite in a normal way, that any one could have courage to commit the act. There was always the love of life and longing for freedom from her troubles. In the latter part of this period she remembers that sometimes when alone with a young, old, or weak person, the thought would seize her that she could kill that person, and that there was nothing to prevent it but her own weak will. It did not grow to be an impulse to do the act; it was only a thought of it. The morbid mental operations before described still went on, but became more systematized. Among a number of strange

experiences at this time, the following may be mentioned: On one occasion, in a public library, she read in one of Dickens' stories a graphic account of a murder by cutting the throat. This affected her very painfully, as if it described a crime of her own. She had no peace till she went again to the library, and from the same book had secretly torn the leaves upon which the murder was described and rended them into shreds. Again, she found in a newspaper an announcement of the death of a person of the same name as C. This so worked upon her mind that she had to select the name of a young lady friend, and adding a letter to it, "to protect herself," she wrote an obituary notice and had it published in the same paper. This caused a great deal of talk, but M. held her peace. On the principle of substitution this act relieved her mind of the suffering she had been enduring. It had been just as if C. had really died and by M.'s own hand—or what was the same thing, because of her own thoughts; she cancelled the idea by the vicarious sacrifice of the other person.

This brings her history to the age of twenty-five years, the time when her relatives recognized her morbid condition, as was stated in the account first obtained. By that time she had reduced herself to the practice of staying much at home and in her room. She did not leave the house for ten months, and again did not leave her room for a year. She became very neglectful of personal care, with all which that implies. At the beginning of this period she had much insomnia, demanded and obtained sedative medicines. These were increased in strength as they lost their effect, till a narcotic mixture was furnished her which she took at will. She "would have it, and did have

it!" She took stimulants also. It can only be learned that the medicine was given at the suggestion of the druggist who prepared it, and was a "preparation of valerian and other strong nervine remedies." It was probably not so potent as she supposed, but the family physician, whom she utterly refused to see, thought "too much of it would be injurious." She could not be induced to give it up, because while taking it she had some peace of mind. In fact, it was the only way of peace for all concerned. She was not thought to be insane. Under its effect and that of stimulants she "could review and analyze, with calm indifference to the suffering, the mental operations of the past ten years." It came clear to her, she says, that her condition was one of insanity. She called it a case of "monomania," and regarded the ideas associated with C. as delusional. She had a comfortable feeling of independence in regard to her conscience, but if the influence of the medicine was not kept up, the mental pain came back. At the end of two years she had increased the medicine largely. Then she also called her father to account for a conversation she thought she overheard, which she found to be a hallucination, and ascribed it to the medicine. She readily recognized it to be such, and this is undoubtedly the only instance of the kind in her history. This, with the druggist's repeated warnings of harm, led to a strenuous effort to stop the narcotic. This made her angry, an unusual event with her; in a characteristic way she vowed she would take no more, and stopped at once. She was sent to the country with an intelligent companion, where she spent a month with great bodily improvement. She was perfectly correct in conduct and attracted much respectful attention. Soon after this, by her own desire, she was placed under special

treatment, and what followed has been narrated. In the first four months she gained physically, in weight and otherwise. Then came the affair of the laudanum and the diagnosis of insanity. Immediately before this she had written a long and interesting letter to her home. The physician's telegram to her relatives announcing her transfer to the asylum was followed by one from herself saying that she was well and telling them not to worry themselves.

The events of her first five months in the asylum have been described with sufficient detail, including the incident which led to a free revelation of her mental history. True to the characteristic habit of negation and antithesis, her pride and reticence had long been accompanied by a fear lest she should betray her secret, and then by an impulse to do so. Both the fear and the impulse grew upon her. But to detail her troubles to me soon came to be a great relief and comfort. Thus was developed another characteristic of these cases—the desire for never-ending repetition. Once engaged in conversation with me, there was no embarrassment in discussing the painful ideas—*no process of stopping for vows, etc.* There was but little material change in her mental operations for the year and a half while the analysis of them which has been given was going on. In general she was much more comfortable, she said, than before her long seclusion at home. This period of comfort represents a remission of the malady which is another of its characteristics; such remissions may last for months, or even years. She occupied her time very well in reading, sewing limited however to a few articles, etc. Later she was able to have some bits of ornament or color in her room. The morbid ideas continued oppres-

sive, but they were managed more methodically and readily than formerly. She was continually having distressing experiences, because of such circumstances as that the name of one nurse and the color of the eyes of another called up painful associations. She preferred that my wishes should be made known to her as directions rather than as requests, because she was thus saved from the difficulty always attending any voluntary action; but the aid gained in this way never amounted to much. Any act that was made a matter of my explicit command could only be obeyed through the system of vows; she could not follow the advice to act under a "new master," as against the imperative idea. The following description characterizes her mental habits fairly well. When she "came up against" any question of doing or not doing something, the thought of the act seemed instantly attended by a great crowd of associated ideas. There was, as it were, a first series of things of which she had to think in a certain order, because they were directly involved in some way with the contemplated act. Then the first series involved another series, and so on through a permutation of very diverse ideas, narrowing at last to the one idea, that through all this indirection the act would carry harm to C. Then, if strongly impelled to do the act, as for example if she wished it or needed to maintain appearances before others, etc., she had to "bind herself over" in the way heretofore described to protect C. from the possible harm. It sometimes happened that after she had bound herself to do or not to do some act, the contrary became imperative. Then there was a dreadful process of counter-vows and "binding over." The associated assemblage of ideas varied for different acts and from

time to time. When the ideas arose she had to run them all over in her mind in a recitative way, always to the same central and final idea. She became very expert at this, and speed was acquired by methodizing the process and by practice, so that she mentally touched the heads of things as she ran through the mental formula. Yet, strangely enough, she could carry herself with perfect serenity and self-possession in the eyes of all but her physicians. It required a great deal of study and analysis to disentangle the thread of evolution of all these subtle and complicated phenomena. She declared that she was then able to talk of them for the first time, but that she could give only the most meagre idea of it all. This writing itself is inadequate in representing what she did give. She said, "When I try to describe my years of trouble, so many distressing thoughts come into my mind that I cannot prune my words of what is not essential."

She always declared that she had no conscience, that no question of moral right or wrong influenced her; that ceased long ago. Her only criterion was to do as near her liking as was permitted by the tyranny of her controlling ideas. She said that in her desperation she did not hesitate in her thoughts to do anything, however wrong it might be, if she desired it, and she could accomplish it by her process of "binding herself over" under penalties for not doing it. In this way see could sometimes defy or rather evade the consequences of acts that at first seemed likely to be harmful. She said, if a duty came in conflict with the ruling ideas she yielded the duty, but if a selfish inclination came up she could evade the harmful consequences. She said also that she had long led two distinct lives: one was entirely within herself,

with its great complication of motives, ideas, and suggestions, and the other was a false pretense ; she was a walking hypocrisy, possessed by an insane idea, without any rightness of conscience or natural affection, selfish and wicked and without repentance for many wrong and disgraceful acts intelligently committed. She betrayed her real conscientiousness by bewailing the wickedness of her conduct. She charged herself with misusing the system of vows which she thought should have been reserved for proper purposes of relief from her painful feelings, when trying to do *right* things ; she misused a blessing, she said, in employing it to get indulgences for doing wrong. But she made too much of the questions of right and wrong in regard to ordinary matters. Her bewailment, however, was more a matter of intellection than of depth of feeling ; the former was so forceful that it was accompanied by a large measure of the corresponding feelings which she knew she ought to have under such circumstances, were they real ones. The depression of feelings was from a sense of oppression of ideas. But through it all there was evidence that all of this was qualified by some consciousness of the fictitious character of that which dominated her mind. In other words, it was still true that, were the domination removed and normal ideation made possible with relation to its limited disorder, she would have been a well and happy woman.

In regard to abstract, painful ideas, not connected with any acts, the like need of her special system continued. Certain words always troubled her in her reading. During the comfortable period of a year and a half now being described she became able to read quite freely until the last, when it was almost impos-

sible. The word "murder" was the worst, and all others expressing acts of violence were almost as bad; next came such words as "jealousy," "hatred," "malice," "sin," and "shame." If, when reading, such a word appeared before her eyes, there was instantly in her consciousness the crowd of associated ideas, and along with them the thought of C. as the object of the act or the subject of the feeling indicated by the word, as if it were M.'s own act or feeling. Thus through some one of a multitude of chains of associated ideas the thought of harm to C. was reached from the "jealousy," "hatred" or "murder-thought." The effect of this had then to be annulled by the self-imprecation of some penalty upon herself if harm did happen to C. It appeared from this that the process of substitution of vicarious sufferers had been changed to one of self-imprecation after the time when she felt herself to be guilty of the deaths of the substitutes and had enacted the murder scenes. To avoid the pain that the future deaths of such persons might cause she chose the new method,—and it was as if she said, on all these occasions, "Let me be punished as guilty of all those acts and the new harmful thoughts, should anything happen to C." This substitution of herself protected C.; then, C. being protected, her own possible future remorse was warded off. When in the presence of others, this process might be dispatched quickly and unobserved; or, if reading, it might be necessary for her to put the book away and go to her room, and there, walking agitatedly to and fro, the whole process had to be gone over many times. On many occasions, at last, she had to find the book and the word repeatedly, and as many times begin anew. Again, the book must be taken to her room, and there

the reading of the word initiated a repetition of the process; she must seek the word and repeat the process many times. There were so many special words, and suggestions of painful ideas in innocent words, that reading became too painful to be attempted.

In the constant mental conflict that was going on the negations of conduct frequently involved questions as to what she ought to do and ought not to do. In this more comfortable period she once told me that a case like hers would be found in Mr. Howells's last book. She said, "Penelope Lapham had the same trouble I have, but not a millionth part as bad," and referred me to Penelope's struggle with her dilemma after Corey, contrary to expectation, had proposed to her instead of her sister, much to her own mental distress. Some time after this event Penelope said: "It's easy enough being sensible for other people. But when it comes to myself there I am! Especially, when I want to do what I oughtn't, so much that it seems as if doing what I didn't want to do, must be doing what I ought." This saying, and others like it, were so true to nature as to make Penelope's case distinctly one of the "insanity of doubting" in one of its more common and milder forms; but fortunately she "recovered," and this was by the logical process of the substitution of the more dominant idea strengthened by the deeper feeling.

During the latter part of this period she was allowed to go about alone in the neighborhood of the asylum "on parole." No explicit promise was exacted, however; she was directed not to go beyond certain limits, with a tacit obligation on her part not to do so. She was better for this, and the privilege was continued for a number of months after she entered upon the next period, which is now to be described.

She afterward said of herself that a crisis seemed to come in her mental condition. All the complications and agitations reached such a tangle of difficulties that she felt powerless to cope with them and seemed to come to a standstill. She said that her conscience reasserted itself in a natural way and began to punish her for her wickedness by compelling her to do everything contrary to her wishes. There was now a real depth of feeling, though morbid, that she deserved punishment, and her conscience seized upon every opportunity for inflicting mental pain; this she felt to be simple justice. At this point in the case there is to be recognized an exacerbation common in the course of such maladies; but more than this, there was now initiated a state that more nearly resembled true melancholia—an essential disorder of the feelings. The gloom and despondency became more pronounced. She had to make herself disagreeable and hateful to the people she liked the best and respected the most, just because they were sources of comfort to her. She said: "It is as if all the wrong things I have ever desperately allowed myself to do and think about now stand around me as creditors of my conscience." A denial of everything pleasant or desirable was thus commanded. She had to speak unkindly to her favorite nurse, for example, and then cried because she had been compelled to do what would make her appear ungrateful.

A change now came about in regard to her relations to me. At first, as has been said, her revelations to me were satisfying, and she had little of the temptation to tell her story to others, which she formerly feared she might be compelled to do. Her sole source of comfort was in such conversations, but the need of

this grew upon her, and at last it became impossible to give her time enough to satisfy her. The temptation to tell others returned with the worry about it, and in the end she yielded to it in some degree. It also came about that she felt the comfort she gained from my visits should be forfeited as one of her punishments. This became the prime issue in her struggle with her avenging conscience. She fought it for months, avoiding meetings with me, "vowing" she would never tell me another word of her troubles, but just as often breaking her vows and talking freely whenever in my presence. Her sufferings increased because these things involved harm to C., and new penalties, and only grew from bad to worse. She began to say, "I must go from here to avoid this suffering; there is no other way. The only hope I ever had has been here, but this I must abandon; anything is better than the suffering I endure here. I must be deprived of my greatest blessing." She felt that if she went away she must leave hope behind. And so the culmination of this phase of the mental phenomena was gradually reached.

All this state of things was believed to be a passing phase of her malady, and she was urged to hope that another remission would come. She could possess herself of this while it was being told to her. A curious thing came about at this time. Not only was the comfort of hopeful words intensified to her, but it was reinforced by telling her how foolish and absurd her mental performances were. But, true to the habit of growth of her morbid mentation, there was need of greater emphasis in the telling to give her equal comfort. At this time an interview usually ended by her saying, "Now, before you go, you know what I

want you to tell me—tell me what you think of me. It helps me to hold on to the idea; what you say seems all real and true to me, but it goes when you go, and I am as helpless as before." As the effect of this, the kinship of human minds had an illustration. My gentler characterizations became chidings and rebukes, and at last denunciations, which exhausted my polite vocabulary. It was curious to observe the calm content with which these objurgations were received, and a little startling to realize the personal comfort of such an unwonted outlet for sentiments that must be habitually repressed. Thus it came to pass that this poor patient brought it upon herself to be the "vicarious object" of stinging words which might have been more fitly spoken.

But now there came a climax in this pitiful history. Like a law of mental habit, the idea of vicarious atonement or substitution that had run all through all these phenomena from the first came into play again. What was told her made her seek for hope though she could not have it. It occurred to her that she might substitute physical for mental suffering—some serious illness or great calamity—some personal injury that would stand in her mind as a lasting token of ample punishment; then the demand for penalties would be satisfied, and her mind would be left free to enjoy in peace the common comforts of life. She invented a plan which bore some resemblance to her former suicidal scheme. On taking a morning walk outside the asylum, she procured a small pistol, and late in the evening, when her neighbor, whom she did not wish to disturb, was out of her room, she shot herself in two places, the shoulder and the hip, making simply flesh wounds. She was perfectly calm about

it and explained that she tried to wound the joints, which she thought would cause permanently painful and crippling injuries. She protested that she carefully avoided endangering her life; for she had virtually pledged herself not to do that. The wounds were trifling and soon healed, her disappointment knew no bounds; the last hope was gone, as she felt; her mental depression rapidly deepened in a kind and degree unknown before; in death was her only relief; she regretted the lost opportunity when she had the pistol. There was now a condition like true melancholia; the suicidal impulse was pronounced, and honestly declared.

She was of course closely watched. Her former state continued and grew worse; she punished herself in every way—in regard to taking food, and in personal care, etc. She would stand in a fixed attitude unable to move for a long time. She contrived new ways of mental punishment—for example, another patient thought she had committed the unpardonable sin, and M. assuming this to be the worst of all sins, imprecated upon herself the punishment, whatever it might be, due to that sin. This idea, however, was so intangible to her that it failed to become embodied in her system of thought. Even in her state of true melancholia there was yet something lacking of the profound feelings of depression and self-condemnation characteristic of that state.

On a later occasion several attempts were made to hypnotize her—to try the effect of "therapeutic suggestion." She did her best to aid in this, but was more amused than otherwise by her swift conclusion of its futility. She said it never could be done, the prime obstacle being that she could ordinarily never go to sleep

without having first cleared, or exorcised, from her mind all the thoughts of evil consequences which had attached themselves to the events of the day and to which she felt that she might perhaps not have done full justice. The poor woman's prayers even had been for years imprecatory. She had, at times, piously prayed for help and strength, but the thought of possible consolation from this source made such relief a subject of punitive deprivation; moreover, her dreadful misuse of the privilege of addressing the Deity debarred her from the proper use of it. Another of her peculiar methods was in some respects not unlike the last. There were times when she could gain herself a respite for a day by first binding herself over to do everything in the natural way for twenty-four hours and not to make any "vows." She occasionally got a great deal of comfort from this device, but at the end of the period she always had to review it and balance accounts in detail. At last, however, after her conscience "had turned upon her," there was an end to this expedient.

This history, already a long one, must be ended here. In this, M.'s last and worst state, it finally seemed best to try the effect of some change, which she earnestly desired, and she was transferred to another asylum. She bore herself passively, but with an evident feeling of regret and as if she had indeed left hope behind. There was immediate improvement in manner, and in the course of a few months her condition became much more comfortable. The change to new surroundings to which she felt indifferent was a great relief. Freed from the oppression of the questionings as to talking with me, she remembered helpfully my explanations, reasonings, and advice. A year

later she was as well as I had ever seen her, appearing very well, intelligent, and ladylike to all who knew her. The secret mental processes went on, however, and, though more submissive, she had little hope. She said her coming to meet me was opposed in her thoughts as formerly, but in her strong desire for the interview there was no hesitation in determining to have it in spite of all consequences. There were no preliminary vows, but she knew she would "have to pay for it afterward." It was natural, vivacious, and most interesting in the abundant proof it gave of mental integrity aside from the limited derangement. At its close she begged me, in the old way, to assure her that it was right to have seen me. No definite information as to her subsequent history has come to my knowledge.

The details of this long story were corroborated in many ways by the agreement of their many repetitions when discussed from different points of approach. Like most persons under the control of morbid ideation, she was in the habit of saying to me, "You would have a different opinion of these things if you could only know more about them; they are so many and so complicated that they cannot be told." Every new and often repeated analysis of the essential nature of her mental processes was readily understood and gladly accepted by her, only to be followed by some new phase of ideation, or memory of past trouble, which would stand more positively in her consciousness than the clear explanation of it all, which she constantly tried and failed to apply.

This history may be briefly summed up. The telling of the story is meant to show the natural and logical growth of complicated phenomena from the central morbid idea; they depended upon this as the limbs,

twigs and leaves hang upon a tree. However distinct and strange any newly revealed product of her system of thought might seem to be, its unity with the rest clearly appeared upon analysis. The minor formulae of her mental operations were all more or less insistent or imperative, strictly according to the closeness of association of the ideas with the central and ruling one; and corresponding also to the degree of fixation of such methods of mentation, by repetition, practice and habit. All these products of mental phenomena are explainable upon the basis of normal psychical law.

The problem of this case was to discover the genesis, the growth and the fixation of the central idea, which in this instance had the peculiarity of being unusually complicated. In the first place, there was probably no special hereditary influence in its origin; the paranoiac element is excluded; certainly the right to infer it must be questioned. If it be said to have been "acquired" because of the typhoid fever at the pubertic period, etc., a neurasthenia must be admitted. But if acquired organic defect be admitted also—while inquiry is excited as to the consistency of this inference —it remains that the "fixed idea" was conceived some years before, disappeared, and was revived and developed when the supposable new factor of paranoiac defect came in.[1] But not only was the conservative

[1] There seems to be confusion and inconsistency in the meaning of terms used in the discussions of this subject. The terms psychosis and degenerative psychosis admirably characterize certain general notions of the mental states they represent, but as definitions there is danger of their use as cloaks for conjecture. Most writers hold that fixed ideas "*almost always*" have a neurasthenic basis; this rates them as psychoses and functional. But as ideational psychoses they lie in the foreground of primary systematized delusions typical of the admitted degeneracies in paranoia. Hence the temptation to unify the view and to regard *all* the "imperative conceptions" as degenerative psychoses; under cover of this term they are brought

tendency to maintain intellectual integrity significant; so also was the absence of the characteristic habit of symbolism. Paranoiacs are prone to symbolism, whereby meanings are betokened by trivial things, and delusional ideas are quickly conceived—for example, the accidental placing of three apples in a row might be believed to represent the Holy Trinity. For this reason there was a negative importance in the limitation of the strong disposition to substitute persons and things the one for another. This did not bring out any innate tendency to symbolism, as was likely to have happened had it existed. There was

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into the category of paranoia. But this term distinctly introduces among the psychoses the new notion of chronic hereditary or acquired defect in the organism. Upon a foundation of heredity it is easy to conceive such organic defect; to invoke a like foundation as "acquired" through a simple concurring neurasthenia has the vagueness of assumption and conjecture. These, therefore, have really no support, in the case of fixed ideas, except the fact of the ideational origin of the latter and their kinship to paranoiac delusions. But the clinical fact remains that their milder forms, at least, are commonly incident to healthy minds; often independent of neurasthenia, they make no trouble, and fail of recognition because they are so little out of harmony with concurrent conditions. Starting with these mild forms, may they not be purely functional, even along with neurasthenia, for some degrees in the scale towards their culmination in the admitted degeneracies? The recognition of two general degrees of fixed ideas (answering to psychoses and degenerative psychoses, between which differentiation is as impossible as to mark the changes from youth to old age) is not out of analogy with the same division that is claimed as necessary in describing delusions. Cf. pp. 227–8.

The *Journal of Mental Science* for January, 1888, received just as this article is going to press, contains the conclusions, p. 532, of Professor Kovalewsky in an interesting article on *Folie du Doute.* He recognizes several degrees, and conditions of origin, of these affections. But he starts with neurasthenia as the common soil from which they spring, belonging to the group of degenerative psychoses including pathophobia and the other forms of these ideational disorders; and neurasthenia itself is regarded as rarely acquired or other than purely hereditary in relation to these cases. This fails to recognize the larger background in the normal field of intellection, where the accidental and irregular coördinations of idea and feeling, indulged, or otherwise fixed by habit, are the germs and often growths which are not degenerative but spring up more readily in soils of purely acquired neurasthenia, or of hereditary degeneracies.

always validity in the factors of her mental equations; the thing substituted was equivalent to the other in quality or effect, and there was logic in the process.

At the root of the whole matter there was a bodily condition somewhat neurasthenic. There was also an unusual intellectual endowment and rare conscientiousness. Upon the mental plasticity of childhood strong impressions were made by unpleasant ideas about "trance" and the horror of being "buried alive." Apprehensions for herself and relatives were engendered in this regard. Here was a quick soil for the natural questionings as to the right and wrong of her conduct to grow to be questionings as to whether her acts were right in respect to their effect upon herself or those dear to her. It was but a shade of change to conceive that her acts were not right in the sense of not being safe, which includes the idea of harm as a consequence. This is the usual significance of the phrase "not right" in these cases. The attendant fear of harm was natural and logical. This combination of the idea and its attendant feeling once formulated, the "impression" once made, the idea became "insistent" and then "fixed," and the "path" was formed by repetition and habit. Here then was the "fixed idea" that some of her acts were not right, which included the idea of harm. This is a common and primitive form of fixed ideas; it was the root of all that grew up afterwards. Next followed the necessity, common in such cases, of repeating acts to make them right, which led to the doubting and hesitating over an act as to whether it was right or not, and to the repeating, doing and undoing of acts. Thus is explained the paradoxical "doubting" associated with

"fixed ideas." Here next was the basis of the habitual negations of thought and conduct—the doing off-set by undoing, the balancing or cancelling of one thought or act by another thought or act—the substitution of one thing for another. From the root-idea that an act was not right came its larger growth and its offshoots, intensifying the impression of the primary idea upon the organism. This was further intensified by the feeling of fear normally attending the idea of harm, the impression of the whole being deepened by habit; its hold upon the soil being strengthened by its growth.

At the beginning, before the age of twelve, the seed of the malady was planted. Its growth was arrested and she appeared to be well till three years later. It might not have appeared again had it not been favored by physical debility. A new growth began; she repeated her acts to make them right. She was relatively backward in her studies, and had a natural desire to excel her companions, which she did. Her love of admiration and attention was perfectly natural, as was her feeling of rivalry towards C., whose unusual loveliness of character and person was more attractive than her own superiority of intellect. Such was Madame de Staël's life-long envy of beautiful women. Such thoughts and feelings are common enough among the young; it was natural enough that her sensitive conscience should reproach her. Thus, with the mental habit already formed there was set up a self-inquisition as to her feeling toward her friend, whom she was afraid of hating, as she soon morbidly accused herself of actually doing. It was but a step then to the thought of harmful things that might happen to her friend, and but another to self-

condemnation for thinking of them, as making her equally guilty as if wishing them to happen. Of course there was exaggeration of feeling in this, but so far in its development there was not, necessarily, anything that might not be common to many conscientious young people. This idea of harm attending her acts, and the accompanying feeling of fear, readily became a concrete idea of harm to C., and to this was added the conception of her remorse as a consequence of harm to C., as if she had wished it. This of course strengthened her specific fear of harm to C., and reinforced the general idea of harm, and therefore the impulse to repeat her acts. Ultimately the question of harm to C. attended all her acts. This established the central idea and mental habit out of which came all its after-growth. From this point the evolution of the mental phenomena was plain enough, as given in the details of its history. The need of repeating acts and "vows" many times—often a definite number—for the sake of emphasis, was a manifestation which characterizes what is called the "counting" variety of cases of fixed ideas. This did not become a prominent feature of this case because it was left behind by larger complications. The substitution process was most curious and constant, but it was only an outgrowth of the primary fact in these cases of doubting, balancing and offsetting one thing against another in an endless series of negations. This process was also one of the remarkable devices for circumventing the dominating idea, as if the characteristic paralysis of the will was limited in respect to that, and the fixed idea stood as an irresistible intruder in her consciousness, while otherwise the will and the intellect were free to evade its control. The murder-acts were simply

dramatic as far as homicidal impulse was concerned. They were extreme examples of what is common in such cases, particularly in the "metaphysical" variety,—an idea at first repulsive worries by its insistence, becomes involved in a process of negations, and at last reasons itself into dominance. Such transitions from one extreme to another of thought and feeling are but exaggerated examples of the law whose order we follow when

"We first endure, then pity, then embrace."

The kindred nature of the great variety of these affections is well indicated by the broad designation of "insistent ideas," as was suggested in the introduction to this article. These aberrations from the normal of well-balanced ideation and feeling, being once initiated, may develop graver forms in cases of the more positively degenerative type, because of paranoiac heredity or acquired defect,—in other words, when there is hereditary or acquired nervous and mental instability; and such cases may more or less quickly develop primary delusional insanity. The commonness of these affections in their milder forms as simply insistent ideas, and their outgrowth from the ordinary and natural operations of the mind, is a matter of great interest. The commonest superstitions, and idiosyncrasies of formulations of ideas and feelings, which control conduct and enforce habitudes, are of this order in their slight departures from sound reasoning. There may be many degrees of these affections before they are recognized as positive disorders. This view of their common origin can best be illustrated by a series of cases in which the early phenomena are more nearly within the range of observation. But even the history of this case is not

inconsistent with this view; nor is it so, as against that of their origin being usually constitutional. For the same reasons it is hardly necessary to search the mysteries of "the inconscient" for the genesis of phenomena which admit a simpler explanation. Many of these affections are to be easily understood as simply accidents or idiosyncrasies of ideation, arising from an incongruous association of ideas, happening according to the common law of contiguity, and becoming fixed in proportion to the intensity of the impressions and by the laws of habit. This may happen in a healthy brain, by mental shock, or by a slower process. This case is an example of the operation of these laws in a plastic organism, with the qualities of a sensitive conscientiousness and fertility of thought, favoring the particular idiosyncrasy. The morbid premise of the fixed idea being once established, it had its own logical sequences. The collateral ideation was normal enough and continued so for many years. There was normal sensibility and feeling except in relation to the fixed ideas and their complications. The will was dominated only in respect to these, and otherwise free and efficient.

The origin of these affections is distinctly ideational, but they well illustrate the inseparable nature of thought and feeling, especially when their genesis is favored by disordered states of feeling. The laws of habit play a most important part in the fixation of such ideas, and much is here to be learned of the nature of the great influence of habit in all forms of insanity. These affections, through the possibility of their comparative isolation, permit the study of the formation of delusions. Again, the rôle of the attention is a leading one in these mental phenomena; the attention is com-

manded in proportion to the insistence of the ideas. In extreme cases of this kind of limitation of the attention there is, side by side with it, more or less activity of consciousness. But it is in this direction that these mental states merge with those described as characteristic of the hypnotic state in its varying degrees of unconsciousness, and of the "limited attention" peculiar to that state. That condition characterized by Professor Stanley Hall's phrase, "tonic cramp of the attention," is most strikingly shown in these affections. The law of suggestion of ideas is active, and even by auto-suggestion the mental attitudes are induced so analogous to physical "cramp." Also the relation of these attitudes to physical reactions is striking. "A diffusive action in the nervous system accompanies all emotion"; for example, a common sequence is fixed idea, fear, pallor, and heart disturbance, etc. It seems in many cases as if the "path" between the ideation and the sympathetic nerve became so open and direct that there is the changed sequence of fixed idea, heart-quake, and last the conscious fear. At all events this last is swiftly overtaken by the automatic organic attitude of fear; and this quick reflex from the idea undoubtedly increases the fear. The man is frightened by his own trembling; he is "a coward upon instinct." This amounts to mental suggestion from the physical field, just as when the hypnotized are put into bodily attitudes that suggest hallucinations. Again, the alliance of these mental states with some forms of "hysteria" is undoubted, and explanatory of it. The medico-legal importance of these conditions occupies a wide field; this very case presents interesting features in this regard.

All these things show the unity of the great problem into which the clinical study of mental phenomena leads. The propositions here advanced involve such important questions, and more than these, in the investigation of this subject; and this case is interesting as presenting so much of the evidence that has led to these views.

A CRITIQUE OF PSYCHO-PHYSIC METHODS.

BY JOSEPH JASTROW, PH. D.

Probably no result of experimental psychology has been cited as frequently and with as much confidence in its truth and importance as the psycho-physic law. By some it has been regarded as worthy of ranking with the law of gravitation, while others refuse to recognize it at all. A clear statement of what the law means is rarely found ; sometimes the term refers to the results of Weber's experiments, and again it refers to Fechner's deductions concerning the relation of stimulus to sensation. But these two are in a sense totally distinct, and should be kept so. The psycho-physic methods are applicable only to such experiments as can be utilized for establishing Weber's law. And this paper is to be devoted to a rigorous logical criticism of the methods and interpretation of such psycho-physic experiments. Its object is a practical one: to clear the way for a more rational system of psycho-physics by directing future experimentation into that path in which it is most promising of results, and thus preventing the employment of the many uncritical and unanalyzed processes now current.

Where the falsity of one point is so closely connected with the falsity of many another, it is difficult to know where to begin and how to proceed. The full appreciation of one point requires a knowledge of the con-

siderations that follow; hence the order of exposition will have to follow convenience rather than logical sequence.

The Three Psycho-physic Methods.

And first let us state briefly what the three usually recognized psycho-physic methods are:[1]

I. *The Method of the Just Observable Difference.*—This is the method that Weber followed in his celebrated experiments, and has, I believe, done much to introduce radical misconceptions into psycho-physics. This method consists in applying a certain stimulus to the sensitive surface of the subject, and then finding the least greater or the least smaller stimulus which can just be recognized as different; one either adds small increments to the initial stimulus until the stimulus thus formed is felt to be greater, or lessens the intensity of the initial stimulus until the diminution is clearly noticed, and notes in either case the ratio of the alteration to the original stimulus. It is considered best to employ both these processes, and regard the mean of the two results thus obtained as the true just observable difference. The ratio of the difference between the initial and the altered stimulus to the initial stimulus, or better, to half the sum of the two, measures the differential sensibility. The smaller this ratio the finer the sensibility is said to be.

II. *The Method of Right and Wrong Cases.*—One here chooses two slightly different stimuli and presents them to the sensitive surface of the subject, requiring him to judge whether the first stimulus is

[1] Other proposed psycho-physic methods, and especially that of the "mean gradations" (*mittlere Abstufungen*), deserve a separate treatment; this I hope to furnish on another occasion.

greater or less than the second, and records the number of cases in which the decision is right and the number in which it is wrong. The ratio of right answers to the total number of answers measures the sensibility and varies in a direct sense with it.[1]

III. *The Method of the Average Error* (or as I prefer to call it, of the Probable Error).—In this method a stimulus is presented, and the subject is required to adjust a second stimulus so as to be equal to the first. The average deviation of the several adjustments from their mean (or better, the probable error of the adjustments) directly measures the sensibility.

Critique of Method I.

Applying the method of the just observable difference to pressure sensations, Weber was led to formulate his well known law. In this he announced that if you apply a certain weight to the skin and find the least greater (or least smaller) weight which can be recognized as different, and then take an entirely different weight and repeat the process, the ratio of the first to the second of each pair of weights used in any such experiment will be the same; that is, the ratio of the just observable difference to the initial weight is a constant. This process simply compares the recognition of a difference in one part of the psychic scale with that in another; it says nothing and cannot be made to say anything about the ratio of stimulus and sensation. It is not a psycho-physic, but a psycho-pyschic, law. So much is plain.

But the experiment of Weber is in every way vague and inexact. To begin with, the bare statement that

[1] This is the usual form of the method. Variations in this proceeding will appear later.

one pressure is "just distinguishable" from another is altogether indefinite. This expression may have as many as four practically distinct meanings. It may refer (1) to two pressures sufficiently different to enable the subject *sometimes* to tell which is which; or (2) to differences that will *always* be correctly recognized; or (3) such as will only accidentally fail to be recognized; or finally (4) it may refer to differences which will be correctly judged any characteristic proportion of times between these extremes. Now the just observable difference will evidently be a totally different thing according to which of these interpretations is chosen. The first interpretation has rarely if ever been used, because in practice any difference that is likely to occur, however minute, will be sometimes correctly appreciated, and will sometimes arouse a confidence in the recognition of it sufficient to hazard an answer upon; yet it has quite as much in its favor as any other interpretation, and leads to equally definite conceptions. The second is the method usually chosen, but is almost sure to degenerate into the third. Under the fourth head any difference of stimuli correctly appreciated any given ratio of times may be used; the simplest is that in which in half the trials the difference is correctly judged, and this interpretation has found favor with some workers.

A very brief consideration of the psychological processes involved in such judgments is sufficient to show that in practice none of the four interpretations is useful or valid. The answer which the subject gives may be of two kinds: (*a*) if he is asked to mention *when* he feels disposed to regard the sensations caused by the two stimuli as different (and probably, too, noting the direction of this difference), his answer depends mainly, if

not entirely, on the minimum amount of confidence upon which he finds himself disposed to make a judgment; (*b*) if he is asked to decide which he judges to be the more and which the less intense stimulus—in other words, if the correctness of the answer (made on the basis of a certain stimulus) is the deciding point and not the disposition to answer, then we are simply using the method of the right and wrong cases in a rather loose form. As a matter of fact, the just observable difference method pure and simple has seldom if ever been used; the correctness of the answer is always to some extent taken into account and in this form the method loses all *raison d'être.*

Again, if we take Fechner's definition of the just observable difference as that difference which will always be correctly appreciated but which cannot be lessened without forfeiting this distinction, we are simply making a special method of that instance of the method of right and wrong cases where (in a limited number of trials) the number of right answers equals the total number of answers. As already noticed, an error here and there is usually considered allowable; but if a few, why not more? Is there anything but the arbitrary preference of the experimenter upon which to base a decision? A more radical objection, however, remains to be noticed. Theoretically a difference of stimuli great enough to ensure a total avoidance of error must be infinite. With a certain ratio of stimuli one may as a matter of fact find no errors, but there is no (theoretical) assurance that if the experiments were sufficiently continued an error would not occur. This point is too obvious to need further illustration. We have seen that in its pure form the method of the just observable difference

simply measures the confidence, the disposition towards answering, and only with whatever accuracy the confidence can be experimentally proved to be a measure of the sensibility, has it value in determining the latter. In the form in which the method is generally used it is simply a loose and inaccurate application of the method of right and wrong cases. The method may be of service in determining roughly within what limits it is advisable to experiment, and has other obvious (practical) uses.

If the mischief to which this spurious method has given rise were confined to the charges already brought against it, the case, though serious enough, would not be as serious as it really is. In addition the method has given rise to radically wrong conceptions, chief amongst which is the conception of the threshold (*Unterschiedsschwelle*). This conception grew directly out of the method of the just observable difference; in fact this difference has by some been taken to be the differential threshold. What is more usually denoted by the threshold is the smallest difference that can be perceived. It is the threshold of consciousness. The moment we define this term accurately its unscientific character becomes apparent. The threshold is described as a point not exactly constant, but nearly so; above it all differences can be felt, below it all differences vanish into the unconscious. No matter whether little or much below this point, they are all utterly lost; it is idle to say, as Fechner at times does, that they differ in the amount of additional stimulation necessary to bring them up into consciousness, unless you mean that the series below the so-called threshold is an exact continuation of the series above it—and if you do mean this, then the threshold loses all its distin-

guishing peculiarities and ceases to exist. Either there is a threshold—be it a point or a more or less variable line—below which is homogeneous unconsciousness; or from the region in which the *sensed* difference has its maximum of clearness down to the point where it utterly vanishes because the difference between the stimuli vanishes, there is a continuous series of intermediate degrees of clearness, and there is no point on the curve with characteristics peculiar to itself, no threshold in any true sense.

But it will be well to postpone further consideration of this point until the nature of the method of right and wrong cases has been delineated, merely calling attention to the fact that, as Fechner and others admitted or even vaunted, the method of the just observable difference is the only one that is closely or at all connected with the threshold theory, and naturally the two may be discarded together. Sensation and stimulation each forms a continuum, and it leads to hopeless confusion to apply discrete conceptions to them.

Critique of Method II.

The method of right and wrong cases is a device by which the sensibility can be determined while the judgment has but the simple problem of greater or less, of yes or no, to deal with. The factors of which this method makes use are the two stimuli of which the larger bears to the smaller a certain ratio to be known as $1 + x$; and the ratio of *wrong* answers to the total number of answers to be known as n. While the ratio $1 + x$ may have any value whatsoever, it actually does not differ much from unity, because only by the employment of such ratios can a number of right and wrong cases be readily collected. The all-important law,

justified by theory as well as by practice, announces that *ceteris paribus* as you diminish the difference between the two stimuli the number of wrong answers will increase, and as you increase the difference between the stimuli the number of wrong answers will diminish. In other words, as $1+x$ increases n diminishes, and as $1+x$ diminishes n increases. This law, that the number of wrong answers and the difference between the stimuli vary in opposite senses (the nature of this variation is not now in question), I regard as *a* if not *the* fundamental proposition of psycho-physics. (There are some conditions as to the nature of the experiments which must be complied with before the law will be found good; these will be assumed for the present and discussed later on.)

The all-important point is to decide how this "inverse law" is to be interpreted. In the first place, having found it true when the two stimuli differ by a quantity x, we expect to find (and will find) it true when they differ by $\frac{1}{2}x$. As, however, the judgments of the subject are under the influence of the many slight variations of condition that always influence psychological processes, it is possible that in a particular instance (especially when x or the total number of trials is small) the difference in the number of wrong answers will fail to appear. But if the number of experiments be increased, *and be increased the more the smaller the value of x*, this difference *will* appear. It must be remembered, however, that it may be impracticable to collect sufficient observations to bring out the more minute differences. But we have a right to infer that under proper conditions they would appear. If I find that as I successively experiment with stimuli that are related as 1 to $1+x$ and then

with stimuli related as 1 to $1 + \frac{3}{4}x$, and then as 1 to $1 + \frac{1}{2}x$ and as 1 to $1 + \frac{1}{4}x$, the ratio of wrong answers, n, successively increases from one to the other, it certainly is in the highest degree improbable that the law does not hold with intermediate fractions of x. In other words, we infer that it can be expressed by a continuous curve, and that we must theoretically regard the probable ratio of wrong answers with two stimuli differing by the ratio x as smaller than the ratio of wrong answers with two stimuli differing by any fraction of the ratio x (1) in general, no matter what the value of x is, and (2) in particular, no matter how near zero that fraction of x is. Any one admitting these propositions (and it is not clear on what grounds they can be questioned) must logically endorse the psycho-physic reform which I am about to advocate; and I cannot but think that if psycho-physics had been built with a due consideration of these propositions, that science would have been a different and a sounder one. As a matter of fact all, even those least in sympathy with the point of view here taken, admit the law (1) in general when the value of x is confined within certain limits, and (2) in particular when the value of x does not too closely approach zero. Of course they have not stated their position in this obviously incorrect way; but if asked to state it they could not, as I understand it, state it in any other way. To show how totally without justification such a position is, it is sufficient to state that the choice of what values of x shall be admitted and what excluded, as well as of what limit is to be set to the lowest value of x, is and must be to a large extent an arbitrary one.

We can now return to the discussion of the theory of the threshold. What from the point of view of the

method of right and wrong cases does the current conception of a threshold demand? Nothing less than the position just now refuted. It has been proved that the ratio of wrong answers increases as the difference between the stimuli decreases; but the "threshold theory" claims that this law fails to hold after this difference has been diminished below a certain ratio. It actually says that you will oftener err in judging between weights of 30 and 32 ounces than in judging between weights of 30 and 34 ounces; oftener in judging between 30 and 31 ounces than between 30 and 32 ounces; but (supposing the so-called threshold to be $\frac{1}{30}$) that you will NOT err oftener in judging between 30 and 30.5 ounces, or between 30 and 30.1 ounces, than in judging between 30 and 31 ounces. Or, from a psychological point of view, it must propound the strange proposition that while under favorable conditions you will be enabled to appreciate the difference between 30 and 31 ounces, the conditions will never be sufficiently favorable to enable you to appreciate the difference between 30 and 30.5 ounces. Although the conception of the threshold is made highly improbable, and even irrational, by the consequences to which it inevitably leads, it is not necessary to be satisfied with a theoretical refutation. One can experiment with several differences all well below the limit assigned as the differential threshold, and actually find out whether or not the ratio of errors with the smaller of any two of these "sub-minimal" differences will be greater than that with the larger. Mr. C. S. Peirce and the writer undertook such a series of experiments (*v. Memoirs of the National Academy*, Vol. III), and found most conclusively that the law that the ratio of errors varies in an inverse sense with

the difference of the weights to be distinguished holds good as far as it is practicable to test it, and presumptively holds good throughout. It certainly holds good far below the limit assigned as the differential threshold for pressure, and if experiments could be sufficiently accumulated would be found good for still smaller differences. I do not forget that it would require an almost infinite series of experiments to make the most minute differences appear; just as at the other end of the scale one would "never" err in judging between 1 ounce and 12 ounces, and "never" in judging between 1 ounce and 13 ounces; yet it leads to more correct and practically useful conceptions to assert that an error is more probable in the former case than in the latter. This train of argument will be perfectly familiar to mathematically minded persons. (For a further discussion of the threshold *v.* Appendix A.)

We are now prepared to consider with more thoroughness the nature of the method of right and wrong cases. While, as the name of the method implies, the experiment is to be so arranged that the subject is to have the choice of two, and no more than two, answers, one of which shall be right and the other wrong, only a small number of experimenters have followed this rule. The violations of it have been of two kinds: first, in allowing the subject *three* answers (by using three kinds of pairs of stimuli, viz., having the first stimulus greater than the second; having it equal, or having it less); second, in allowing the subject the privilege of answering in one of these ways, or of saying that he is "doubtful." The objections to the first of these proceedings are evident and conclusive. As will be presently seen, one of the conditions on which the validity of the method of right and wrong cases depends is that the number of answers correct by the

action of chance shall be known ; and the possibility of three answers introduces an awkward and useless confusion into the calculation of these chances, and requires a much larger number of experiments to ensure equally reliable results. For in each case the answer given by the subject may be (1) correct, (2) singly wrong, and (3) doubly wrong ; *e. g.* if the first stimulus is really more intense than the second the subject may call it greater and his answer be correct, may call it equal and his answer be singly wrong, or may call it less and his answer be doubly wrong. The calculation of the chances of a correct, a singly wrong, and a doubly wrong answer by mere guesswork is certainly a very delicate one, especially when you consider that when the stimuli are really equal a doubly wrong answer is impossible and there are two ways of having a singly wrong answer. Again, with fine differences it will be difficult to keep the three kinds of sensations in mind, and slight lapses of the attention in such cases would favor the judgment that the stimuli are really equal. But objections to this proceeding could be indefinitely multiplied,[1] and one very curious one is given further on. Suffice it to say that it has no point whatever in its favor, and is really antagonistic to the spirit of the method upon which it foists itself. The method of right and wrong cases is a justifiable and a good one for measuring sensibility ; the method "of right, wrong, or equal cases" is certainly a different one and has no justification.

The objection to allowing doubtful answers is also apparent. If you do allow them, what are you to do with

[1]A very serious objection is that it will be difficult, if not impossible, to take adequate account of the difference in sensibility for an increase and a decrease of sensation, which, it will be shown later, it is necessary to do.

them? Neglect them? Then when your x is very small you will have to throw out most of your experiments, and will in fact be recording only the best ones; while the very condition that makes the method of right and wrong cases a valid one is that *all* errors be recorded. Errors are due to slight lapses of the attention and all the other fluctuations to which the judgment is subject; to allow doubtful answers is to rule out all cases in which the judgment is in a somewhat worse than its average condition, and thus to vitiate the real average. It would be quite as justifiable (in fact, if you do the one you ought to do the other) to rule out all cases in which the subject feels *unusually certain* of the correctness of his answer. But may we not, as Fechner[1] and many others did, count half of the doubtful answers right and half wrong? Certainly not. (1) Because all judgments must be recorded as given; (2) because that would give a fictitious appearance of having made more observations than you really have, and when x is small (and the number of doubtful answers large) would seriously influence the meaning of the result; (3) because, while it is true that the chance of any answer in general being correct is one half, it is not at all likely that the chance of this particular kind of an answer being correct is as much as one half. Other more practical objections to the process are that it encourages fatigue and diminishes the regularity and simplicity of the judging process. In fact the only point in favor of this proceeding is that this doubtfulness is a real and valuable symptom; but a truer and

[1] Fechner used this method at first, but gave it up later. It is to be noted that if you allow "equal" answers you *certainly and especially* cannot count the doubtful answers half wrong and half right, because in that case the chance of a right or wrong answer is not one half.

better mode of taking this into account is described under the term "confidence" in Appendix B.

We are now able to define the method of right and wrong cases, and having done so, may pass on to its theoretical justification. The method may be formulated thus: Having chosen two stimuli of which the one bears to the other the ratio[1] $(1+x)$, apply them to the sensitive surface of the subject, requiring him to decide in each instance whether the first stimulus is greater or less than the second (one of these answers being right and the other wrong, so that by mere guesswork he will answer correctly in one half the cases), and record the ratio (n) of wrong answers to the total number of answers.

As already stated, the errors may be regarded as due to lapses of the attention, slight fatigues, and all the other numerous psychological fluctuations that go to make us now better and now worse judging agencies than our average selves. These influences may be said to have the effect of loading the smaller stimulus (or lightening the larger) so as to come up to (and, strictly speaking, just overtop) the greater stimulus. As long as $(1+x)$ remains constant, the "amount of work" which these accidental fluctuations must perform in thus loading the smaller stimulus sufficiently to cause an error remains constant, and is really x; hence, as $1+x$ diminishes this work diminishes, and as $(1+x)$ increases it increases. These fluctuations, it is understood, are of such a nature as to be as frequently and to the same degree in favor of our judging powers as antagonistic to them; and the probability of their accumulating sufficiently in one direction to cause an

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[1] $(1+x)$ and not x is chosen to show that the ratio of the larger to the smaller stimulus is designated; this choice is made on grounds of convenience only.

error when the first stimulus bears to the second the ratio $(1+x)$ is less than the probability of their doing so when the ratio of the two stimuli is less than $(1+x)$, and is greater than when that ratio is greater than $(1+x)$—*i. e.*, with a smaller $(1+x)$ errors are more probable and hence will occur more frequently than with a larger $(1+x)$. And the law that regulates the probabilities of the deviations by various degrees from the average (*i. e.*, the frequency of error with various stimulation ratios $(1+x)$) is the law expressed by the "probability curve," which pictures the effect of a very large (strictly infinite) number of small causes no one of which has of itself any decided influence. And here we have touched bottom. This law forms the basis of the method of right and wrong cases, and enables us to predict what ratio of errors will occur with any value of $(1+x)$ when we have experimentally determined in a given case this ratio, n, for a given value of $(1+x)$.[1] The formula for doing this, together with illustrations of its application, is given in Appendix C.

As the object of any psycho-physic method is to measure the sensibility, it remains to show how this is to be done, and thus to supply the want which the just observable difference was intended to meet: namely, to afford a ready method of comparing the variation of sensibility in different individuals, at different times, with different modes of judging, in

[1] The paper by Mr. C. S. Peirce and the writer, above referred to, illustrates the close correspondence between theory and practice in this respect. The only difficulty in showing this arises from the fact that the probable error is constantly decreasing (due to practice and so on), and one must therefore divide the results into groups within which the probable error is presumptively tolerably constant. This consideration must also be taken into account in calculating an n for a certain $1+x$, on the basis of several n's obtained with several $(1+x)$'s.

different senses, and so on. The frequency of error with each value of the ratio $(1+x)$ is expressed by a continuous curve when $(1+x)$ changes gradually; there is no characteristic point on the curve evidently appropriate for the standard of sensibility, hence the choice of such a point must be made on grounds of convenience and simplicity. The standard of sensibility that I now propose is that ratio of the two stimuli (or rather that ratio less one) with which one half of the answers being correct by chance, one half of the remaining one half of the answers will also be correct—*i. e.*, when *one* error occurs in every *four* answers. The reason of this choice is that this ratio measures the probable error, or that error which is as likely to be exceeded as to be fallen short of. This will be fully explained in considering the method of the average error, and it will there be shown that this standard of sensibility forms the easiest possible transition between the method of right and wrong cases and that of the average error; which, I take it, is an essential requisite of a standard of sensibility. Of course it is not necessary that this value be experimentally found; it is to be calculated by the formula given in Appendix C, from any ascertained ratio of error with any ratio of stimuli. If several such data are at one's disposal it is to be calculated from each, and the mean drawn or treated in what is recognized as the fairest manner.

Having thus obtained a standard of sensibility, it only remains to illustrate its application and to mention some practical conditions which this method makes advisable. I will call that ratio of excitation with which errors occur once in four times the "*standard ratio.*" If, for example, I find as the

result of 1000 experiments with two weights 200 and 210 grams, that 250 of the answers are wrong (or calculate from an equivalent set of experiments that at this ratio of stimuli that proportion of answers would be wrong), then the sensibility of the pressure sense in this case is $\frac{1}{20}$. (The stimuli being 200 and 210, $1+x=\frac{210}{200}=1+\frac{1}{20} \therefore x=\frac{1}{20}$). If in a following series of experiments I find 250 mistakes when the stimulation values are only 200 and 208, then the sensibility has improved from $\frac{1}{20}$ to $\frac{1}{25}$; and thus the sensibility is said to be twice as fine (not when half the ratio of errors are made, but) when the ratio of stimuli necessary to produce the same ratio of errors is halved. If in a given case I find that A makes fewer errors than B, I have only to calculate the standard ratio for each in order to quantitatively ascertain the ratio of their sensibilities, which are inversely proportional to their standard ratios. And finally, I can compare different senses on the generally admitted supposition that their sensibilities are to be measured by the *ratio* of the stimuli (apart from their absolute value) leading to equal ratios of error. This comparison would lose much of its significance and validity in case Weber's law does not hold; for then no such method of comparing entirely different senses would exist, inasmuch as the absolute value of the stimulus would then be important and there is no connection between an ounce and an inch. If Weber's law is true within limits, the comparison holds only within those limits.

If the plan of experimentation thus far sketched were followed there would be little room for serious error, and the experiments of various observers would be generally comparable. I will, however, add some suggestions and precautions, all of which have proved themselves highly advisable, if not essential.

(*a*). It should be stated what knowledge the subject has of the conditions and purposes of the experiment, and the subject should know all the conditions except such as will lead to the use of indications towards forming a judgment other than those furnished by the sensation itself. If he is in doubt as to the several changes that can possibly occur he will infer them for himself, and will yield to that uncontrollable psychological guessing of what is coming. This mischievous tendency plays havoc with the expectation and throws the attention off the track. When the confidence is low the tendency to prefer one kind of answer is apt to occur, and would be avoided if the subject knew that this tendency had no basis in fact. It is especially necessary for the subject to know that in each case the one stimulus is greater or less than the other (and never equal to it), and that either is as liable to come first as last.

(*b*). The greater sensibility for an increase than for a decrease of sensation must be taken into account. This simply means that as a matter of fact one is more apt to perceive a change from 20 ounces to 21 ounces than a change from 21 ounces to 20 ounces, and therefore the two experiments should not be placed on a par. This caution is quite usually observed; but what seems to me the easiest method of avoiding the difficulty is used, as far as I know, only in the experiments on "Small Differences of Sensation" above referred to. It consists in having one of each kind of change in each experiment. For example, in the above case the order of the weights would be (1) 20, 21, 20, or (2) 21, 20, 21, the subject being required to decide whether the middle stimulus was greater or less than the first and third stimulus. The mean of two sets in one

of which only "increases" and in the other only "decreases" are used is very good, but multiplies the number of experiments without in general yielding any compensating advantages. Cases may arise, however, in which the first mentioned process is inapplicable; but these are rare, and in general the "double process" is advisable. It gives two chances of judging and makes the conditions highly favorable. It should be distinctly stated which method is used. In either method one half the answers will be right by the action of chance.

(*c*). It is highly advisable to have as many of one kind of change as of the other, *i. e.*, as many "decreases" followed by "increases" as *vice versa*, or, if the other method is used, as many "decreases" as "increases." This is generally conceded; and the only point worthy of mention is that one can avoid the subject's taking any unfair advantage of this fact by having a large number of experiments in one set. If that is impracticable, divide a large set composed of an equal number of each kind of change by a *chance* arrangement into smaller groups. In general let a *chance arrangement* (die throwing, etc.) decide the order of the several kinds of changes.

(*d*). A precaution that I have found of great value is that the moment at which the change is to occur shall be under the control of the subject, and not, as is usual, at the command of the experimenter. In this way the subject knows exactly *when* to expect the sensation, and he can ask for it at the moment when he is best prepared to receive it. Any slight non-distracting movement can be agreed upon as the signal to mean "change." This is a greater advantage than would at first sight appear.

(*e*). It is hardly worth while adding that the method should be the same throughout, that the conditions be kept as equable as possible, that the effect of practice be noted and of fatigue avoided, and so on and so on.

It will be worth while illustrating by a single example, to what kind of work the employment of a wrong method leads. The author in question is experimenting with the pressure sense.[1] With a constant initial weight of 10 grams he successively increases the differential weight from .1 gram up to the point where, in a set of 16 trials, no wrong answers occur. He thus uses the so-called method of the just observable difference in its worst form, and arbitrarily fixes the point of no error at no error in 16 answers. Not satisfied with this, he in some cases allows an error or two and still calls it the just observable difference. Again, he has three pairs of changes; beginning with 10 grams he either (1) increases, (2) repeats it (equal), or (3) decreases it. He thus makes it impossible to know the number of answers correct by chance. The answer when the change was an increase or decrease may be correct or doubly wrong (*conträr*); when the weights are equal it may be correct or wrong (*falsch*). What happened when the subject said the weights were equal but they were not so is not recorded. Finally, the subject could always say, if he chose, that he was undecided (*unbestimmt*). The object is now to increase the differential weight until only "correct" answers remain, or nearly so. With differences of .1, .3 and .5 gram the *whole table* conveys the important information that the subject never felt like answering at all. With .4 gram he begins to answer,

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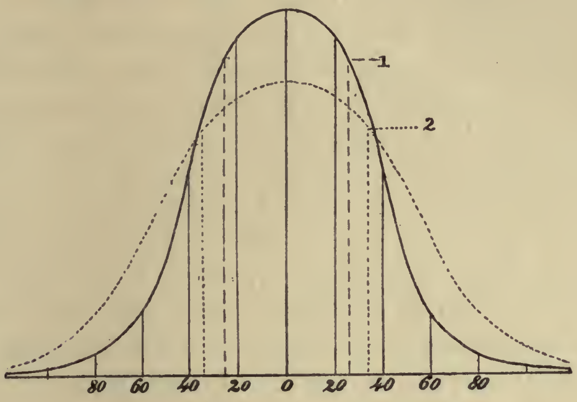
[1] *Experimentelle Prüfung der zu Drucksinn-Messung angewandten Methoden*, etc. Von Dr. Bastelberger. (Eine von der Universität Strassburg gekrönte Preisschrift.) Stuttgart, 1879, pp. 70.

frequently makes mistakes, and at last when the 10 grams are increased by 4.5 grams, or the ratio is nearly 2 : 3, he commits no errors in a set of 16 trials. In this process there were 192 experiments, in *only* 68 of which did the subject give a definite answer. Up to the very last "doubtful" answers occurred. Results like this are utterly unreliable. They show nothing, and are not comparable with the results of others. What has been done is to show that in a particular set of 16 experiments the subject was disposed to answer each time and made no errors, and that with small differences the confidence is low. It is certainly not to be supposed that if the experiments were repeated one would get the same number of doubtful, of right, of singly wrong, and of doubly wrong answers, with the same ratio of stimuli; and if they differ, we may not be able to tell whether the change is an improvement or a deterioration. Again, the results say that when I put 10 grams on the finger and then take it off and replace it I will not know that the same weight has been replaced, if this occurs in a series when the greatest change to be expected is an addition or diminution of .1 gram, but that I will recognize this *very same* act when it occurs in a series in which changes of .4 gram are made. This difference can only be due to contrast with the preceding and the expected sensations, and is therefore an effect which interferes with an accurate determination of sensibility. And all this is simply the effect of allowing "equal" answers. In short, a correct method would yield results which included these and said much more in half the time.

Critique of Method III.

We come at last to the most natural and in some respects the most important method, that of the average error. This, like the former, is founded upon the probable error; in fact, the x of the standard ratio is the probable error. To show what elements are involved in this method and how they are dealt with, let us take a particular instance. Let the problem be to draw lines equal in length to a given line; in so doing the average result will be (1) to draw a line really equal to the original line, *i. e.* the several exaggerations and under-estimations will balance one another; or (2) to draw a line slightly longer, or (3) one slightly shorter, than the original line. In either case let the point marked zero represent the average result of the reproductions; the points 20, 40, 60, etc. to either side denoting reproductions differing from the average by 20, 40, 60, etc. per cent of the average respectively. Now in any extended series of such experiments the number of reproductions of nearly the average length will be larger than the number of reproductions differing more from the average. And the law which this grouping about an average follows is that expressed by the probability curve. In other words, that curve pictures the frequency of each degree of fluctuation to which the judgment is exposed, the abscissae measuring the extent of the error in each direction, and the ordinates the ratio of errors of each degree of error. The *average error* of these adjustments is obtained by dividing the sum of the deviations from the average (without regard to sign) by the total number of adjustments; the *probable error* is obtained by simple mathematical processes (explained in Appendix D, *q. v.*), and measures the

limits within which any observation is as likely to fall as it is to fall beyond them. It is that point on the curve the ordinate from which divides each half of the curve into two equal areas, and is thus represented by the dotted ordinates.



This probable error is the gauge of variation in sensibility from day to day, in different individuals, and so on. The point which it marks is chosen mainly for convenience and the simplicity of the formula to which it leads.

Let me illustrate how the probable error measures the sensibility. If to-day I am in a better judging condition than I was yesterday, my probable error will be less; this means that I will be more consistent, be less subject to large disturbing variations, and react more nearly in the same way on each occasion. This is what is indicated by the probable error, and (as we saw in the method of right and wrong cases) is what we do and ought to mean by being able to judge better. Again, if A is a better observer than B, the complete significance of this fact is expressed by saying that his

probable error is less than B's; this is fully recognized in astronomical and other exact observations. It is not an ultra-refinement, but is at once the simplest, most accurate and adequate mode of expressing those differences with which psycho-physics deals. Finally, to say that one sense is finer than another is to say that its probable error is less. For example, the sense of vision is finer than the pressure sense; this means that if I repeatedly select from a large number of slightly different weights one that shall equal a given weight, the point in each half of the curve which has an equal number of errors to either side of it will be farther off in the pressure curve than in the curve resulting from matching two lines by the sense of vision, as shown in the figure. Moreover, the probable error furnishes a quantitative estimate of sensibility. If A has twice the sensibility of B this means that his probable error will be one half that of B. If the effect of practice is to increase my sensibility by one half its first amount, my probable error will decrease by one third of its amount, ($\frac{1}{1.5} = \frac{2}{3}$; $1 - \frac{2}{3} = \frac{1}{3}$).

Let us return for a moment to the three possible results of the method of the average error (or, as we have just seen reasons for terming it, the probable error) as above given. If the average result of all the adjustments equals (or nearly equals) the real intensity of the first stimulus, it shows that the causes leading to error in one direction are equal in efficiency to those causing errors in an opposite direction. If, however, the average result of all the adjustments shows a constant deviation (either greater or smaller) from the original stimulus, then there is a constant and a variable error, which two are totally different and independent things. The constant error must be ascribed

to some peculiarities of our organism and so on, and has no value whatever in measuring the sensibility; this, as before (and always), is measured by the probable error of the deviations of the several adjustments from their mean. The constant error measures something very important and forms a special object of research. But, it will be asked, how will this constant error appear in the method of right and wrong cases? As regards the ratio of error it will not appear at all. This constant error would appear in the curve as a shifting of the central axis to one side. This does not affect the probable error, which alone decides the ratio of error in the method of right and wrong cases. Why it does not thus appear may be seen from the following considerations. The constant error makes the probability of a certain deviation—inasmuch as that deviation is made larger by the existence of the constant error —*less* than if no such error existed; but this is exactly counterbalanced in those equally frequent cases in which the constant error aids to the same extent in *lessening* the degree of a deviation. For example, if the effect of the constant error is to lead me to regard a line $\frac{5}{4}$ of the first line in length as its equal, then in the method of right and wrong cases this means that the probability of my making an error of any degree is made less because I must now make an error $\frac{5}{4}$ of its size; this is when an increase is taken to be a decrease. But when I mistake a decrease for an increase, the additional $\frac{1}{4}$ to the length of the line by that much *decreases* the size and increases the probability of such an error. But if the effect of the constant error is such as to always make the altered (not the initial) stimulus seem larger, then the constant error will appear in the fact that more errors in taking a decrease to be an

increase than *vice versa* will occur; and in fact we can quantitatively determine the constant error by taking half the difference between the probable error of all the judgments of one kind and that of the other kind of judgments—a proceeding which I do not remember to have seen in practice.

There are no special precautions necessary in carrying out this method. It is natural and easy, but not practically applicable to all senses. One must take care that the subject really has a free choice of all such reproductions as he is at all likely to choose.

Conclusion.

It will have been noticed that this critique has dealt solely with the theoretical and practical justifications of the three usually recognized psycho-physic methods. It has avoided any reference to the psycho-physic law in Fechner's sense, and only in a few places has it been led to consider Weber's law. Weber's law is either (1) true throughout the psychic scale, or (2) it is not true at all, or (3) it is true within limits. In the second case, as has been noticed, we lose a valuable method of comparing the accuracy of different senses unless a law similar to that formulated by Weber can be proved to hold. In the third case we must limit our comparison of different senses to those absolute stimuli which show the greatest tendency to be in accord with Weber's law. The question of a practical correction for the lower and upper end of the sensitive scale in each sense is a separate one, and cannot be considered here. My object now is to point out that a main function of Weber's (or any similar) law is to supply a method of comparing the sensibility of different senses, and the

function of the two legitimate psycho-physic methods is to furnish standards of sensibility in the several senses. The results obtained by either of these methods can be expressed in terms of the other. The difference between them is in the psychological processes of which they make use; and it is possible that this difference is so great as to some slight extent to vitiate the mathematical relations that have been deduced for transition from one to the other. This can only be decided by actual experiment; and such experiments, if sufficiently numerous and carefully conducted, would form a valuable contribution to the subject. If the result were to show an agreement between theory and practice (as I believe it would), it would give an especial significance to the definition of man as a rational animal.

Finally, a word as to Fechner's law, which reads that the sensation is proportional to the logarithm of the excitation. That law in one sense, I believe, can be deduced from Weber's experiments only by the use of a series of assumptions, hardly one of which is even probably justifiable. Fechner has confused "the sensation of being different" with "the difference of sensation," and his law seems to me, in the sense in which it is often, if not usually, stated, to be without truth or meaning. But I reserve all criticism of this as well as of other fundamental propositions in the logic of psycho-physics for another occasion, and will conclude this paper with a summary of the main points which have been advanced therein.

(1). The method known as the method of the just observable difference is either not at all suitable for an exact measurement of sensibility, or it is but a loose application of the method of right and wrong

cases. It should therefore be omitted from the psychophysic methods, where it has introduced much confusion and many misconceptions.

(2). The threshold is such a misconception, arising from a discrete mode of regarding continuous quantity; and is as valueless as a standard of sensibility as it is unjustifiable theoretically. The variations of the probable error form a continuous curve, while the threshold theory requires a more or less sudden change in the direction of this curve.

(3). The method of right and wrong cases is justifiable when used with certain precautions; in particular, when but two answers are possible and but two kinds of excitation are used; when the subject is required to record a definite answer each time; when the number of answers correct by chance is known (and equals one half). Other advisable rules are given in the text.

(4). The justification of this method lies in the fact that the causes of error follow the probability curve; and thus a means is furnished of calculating either the ratio of errors at any given ratio of stimuli, or the ratio of stimuli at any given ratio of error, when the ratio of errors at any one ratio of stimuli is known.

(5). The standard ratio by which sensibility is to be measured is that ratio of stimuli at which one error occurs in every four answers.

(6). The method of the average error (better, of the probable error) depends directly on the ascertaining of the probable error; and the probable error itself measures the sensibility. The x of the standard ratio in the method of right and wrong cases is the probable error, and this fact yields a ready method of comparing the results of the two methods.

(7). The function and value of Weber's law depends

on its furnishing (it may be within limits) a means of comparing the sensibility of different incommensurate senses. It can be formulated in terms of the method of right and wrong cases, as saying that the standard ratio is independent of the absolute value of the stimuli but depends solely on their ratio $(1+x)$; and in terms of the method of the average error, as saying that the probable error will be uninfluenced by a change in the absolute size of the stimulus according to which the adjustments are to be made.

Appendix A.

The Practical Threshold.

While I maintain that the theoretical refutation of the threshold theory and the establishing of the point of view of the probable error carries with it the assurance that no practical difficulty to which they may give rise will be more than an apparent one, yet it may be worth while showing how such objections are to be met. The favorable evidence which the assumption of a threshold derives from ordinary experience can be illustrated thus: We do not see the stars at day, yet they are there. This can only be because the lustre added by their brightness to the enormous sunlight already existing is too insignificant ever to appear visible to our eyes; it is lost below our differential threshold. In so extreme an instance the difference between the current view of the threshold and the one here advocated becomes theoretical only; but that does not lessen its importance. Consider the facts more closely; at day the star is invisible, at night it is visible. Hence, the argument reads, there must be a point where the visible passes into the invisible at dusk and comes back into the visible again

at dawn. The question is, what is the correct mode of describing this process. The current method is this : the ratio of the brilliancy of the star to the already existing light is constantly increasing, and when this ratio has increased beyond a certain amount (the differential threshold for vision) the star becomes visible. My explanation would be this. I would first call attention to the fact that the star would be invisible to some persons when it is visible to others, would under parallel conditions be invisible to me one day at a given time and visible the next day, in order to show that the term threshold is intended to refer to an average threshold. I would then ask whether you will always be able to see the star a minute time after the ratio of its brilliancy to that of the sun has increased above the ratio referred to. If you answer "yes" you define your threshold to mean that ratio of the brilliancy of the star to the sun at which all your answers will be correct. Here you either (1) tacitly assume that not many observations are to be taken, or that (2) no matter how many observations were made no mistake would ever occur. If you mean the former you admit that if the observations went on errors might occur ; but the causes which led to these errors have not totally vanished, but have only gradually decreased without any sudden break in the process—*i. e.* without any threshold. If you mean the latter you are claiming a very improbable proposition ; for the causes leading to error still exist, and though very minute, and errors rare, still they are never impossible. *Practically* they will be impossible after a certain more or less definite point ; but this simply means that it would be impracticable to collect sufficient observations to ensure the occurrence of an error. One can agree to mean by a *practical* threshold that ratio

of excitations at which no more than one in a hundred or one in two hundred answers will occur—*i. e.* one can agree to neglect all causes of error not sufficient to produce at least one error in one or two hundred trials; and can use this as a standard ratio, to be calculated as the other standard ratio. But reasons have been given for preferring the standard ratio first proposed. If, however, a practical threshold be desired, it can be agreed upon, but it will not be a real threshold in any true sense. The star would be far below such a practical threshold.

I am indebted to Dr. Fabian Franklin, of Johns Hopkins University, for pointing out that there is a form of the threshold theory consistent with the mathematical basis here advocated. It is this: we can imagine a ratio of stimuli differing very slightly from unity which a judgment less subject to fluctuations than ours would (owing perhaps to some peculiarities of its organism) more often disregard. And the more perfectly free from fluctuations such a judgment is, the more automatic the process of judging, (not the more often will this small difference be perceived but) the more often will it *just fail* to be perceived. We are dealing not with more and more observations but with a better and better judgment. And as this judgment approaches perfection we can imagine it perfectly perceiving certain differences and perfectly failing to perceive all differences below a certain fixed difference, which would thus be the threshold.

In reply to this I have only to state that (1) from the experience that we have we can assert that such a state of things is extremely improbable, and (2) that if it were true it would necessitate the same psycho-physic methods which are here considered valid, and that in

brief the practical outcome of it would be quite the same as those that arise from the theory here advocated. It might be worth while devising experiments to test the possibility of this supposition. It is to be noted that this form of the threshold theory is as antagonistic to the old threshold theory as the one advocated in this paper. Such a threshold must be very much more minute than any value assigned as the differential threshold in the old sense.

Appendix B.

The Method of Gradual Increment.—The Confidence.

In discussing the method of the just observable difference it was implied that though the usual method of that name was not valid, there was a genuine form of the method. In its true form it has recently been applied to the study of the pressure sense.[1] It consists in allowing the initial weight to change *gradually*, and to find *when* the subject detects the direction of the change—whether an increase or a decrease of pressure.

A study of the nature of this proceeding sheds much light on the operations involved in the process of judging. The sensation gradually changes, and the question is how soon is this change detected? In the first place it is to be noted that there are two variables, the rate of change and the amount of change. For the sake of simplicity suppose the rate of change constant. By how much must my sensation change before I am willing to decide in what direction it has changed? My point is that this is to a large extent an individual matter. It means what is the smallest amount of confidence upon which I will risk a judgment. If I wait until I feel perfectly certain about it

[1] See the article by Hall and Motora in No. 1 of this Journal.

my "just observable difference" will be large; if I judge as soon as I have a minimal amount of confidence I will have a small "just observable difference," but will doubtless make many mistakes. This feeling of confidence is what the "just observable difference" method takes into account. And we would expect that the ratio of errors in the method of right and wrong cases varies in an opposite direction not only with the difference judged, but also with the confidence in the correctness of that judgment. When the difference of the stimuli is constant the number of errors in the various sets will vary "inversely" as the confidence; and hence this subjective feeling may be utilized for recording the differences between individuals and between different series of judgments of the same individual. The feeling of confidence will itself be liable to variations, but every one will doubtless have a tolerably constant "index of confidence."

We see thus that in its true form the method of the just observable difference measures the disposition to answer, and this in turn is determined by the subjective feeling of confidence. The method is calculated to shed much light on the subjective states that accompany the act of judging, but though valuable in other directions, is not suited for measuring sensibility. It is also to be noted that as a considerable variation in the confidence from time to time, or even between different individuals, is not to be expected, that feeling of confidence which prompts one to answer may be considered sufficiently constant to enable one to base a rough measurement of the sensibility upon it and not upon the correctness of the answer. And in this way the just observable difference as ordinarily tested may be useful in hurriedly

testing sensibility, in pathological cases and elsewhere. What I have said is not opposed to such a use of it.

To record the confidence is a difficult and must to a large extent be an arbitrary matter. In the experiments on "Small Differences of Sensation" we used the following plan: 0 denoted the absence of any preference for one answer over its opposite, 3 denoted as strong a confidence as one would have in ordinary sensations, and between the two 1 and 2 naturally found their places. From records made on this plan Mr. Peirce deduces the formula $m = c \log \frac{p}{1-p}$, where m denotes the degree of confidence, p the probability of the answer being right, and c a constant which may be called the index of confidence. This formula closely approximates the results actually obtained. It appears, too, that with increased practice the index of confidence rises.

It was above deduced that the confidence must vary in a direct sense with the ratio of the stimuli, and in an opposite sense with the ratio of errors. This is very clearly shown in our experiments. Mr. Peirce's average confidence was .67 when the two stimuli were 1000 and 1060 grams; was .28 when they were 1000 and 1030 grams; and was .15 when they were 1000 and 1015 grams. Similar numbers for myself are .90, .51 and .30; and when the ratio of the stimuli was further diminished my confidence was still further reduced. With the stimuli 1000 and 1005 grams it was practically zero. In a paper published by the writer in *Mind*, No. 44, similar results are shown.

Again, the confidence varies in an inverse sense

with the number of errors. In Mr. Peirce's case only 3 per cent of all answers given with a confidence 3 were wrong; 10 per cent of those with a confidence 2; 18 per cent of those with a confidence 1; and 38 per cent of those with a confidence 0. Similar numbers for myself are 3, 6, 16 and 30 per cent. In spite of the obvious arbitrariness and inadequacy of this method it has proved itself surprisingly useful; it ought, however, to be improved in future work.

Appendix C.

Formulae for the Method of Right and Wrong Cases.

For these formulae as well as for important suggestions in several parts of this paper I am indebted to Dr. Fabian Franklin.

I. Rule for calculating the ratio of the two stimuli at which one fourth of the answers will be wrong when the ratio of wrong answers at any one ratio of stimuli is given.

Let $(1+x)$ be the given ratio of stimuli; let $(1+p)$ be the ratio at which one in four of the answers will be wrong; and let n be the ratio of errors with the ratio of stimuli $(1+x)$. The formula is

$$\log(1+p) = \frac{.477 \log(1+x)}{\theta^{-1}(1-2n)},$$

in which $\theta^{-1}(1-2n)$ means the t in a table of θt corresponding to $\theta t = 1 - 2n$. Such a table is here appended and is taken from the article on Probability in the Encyclopedia Britannica, 9th edition. (It is to be noted that as the logarithms appear finally as a ratio they may be taken in any system of logarithms.)

Example 1.—In distinguishing between what weight and 100 ounces would A answer wrongly once in four

times, if he makes 15 errors in 100 answers when distinguishing between 100 and 105 ounces.

$$n = .15\,;\ 1-2n = .7\,;\ \theta^{-1}(1-2n) = \theta^{-1}(.7) = .7345\,;$$
$$1+x = 1.05\,;\ \log\,(1.05) = .0212.$$

$$\log\,(1+p) = \frac{.477\,\log\,(1+x)}{\theta^{-1}(1-2n)} = \frac{.477(.0212)}{.7345} = .01377\,;$$

$1+p = 1.032$. *Answer:* Between 100 and 103.2 ounces.

Example 2.—If in distinguishing between the brightness of two screens, the illumination of one of which is brighter by $\frac{1}{50}$ than the illumination of the other, B errs on the average 19 times in a set of 50 observations; what ratio of brightness must the second screen bear to the first for B to make only 12.5 wrong answers on the average, in a set of 50 observations?

$$n = .38\,;\ 1-2n = .24\,;\ \theta^{-1}(1-2n) = \theta^{-1}(.24) = .2164\,;$$
$$1+x = 1.02\,;\ \log\,(1.02) = .0086.$$

$$\log\,(1+p) = \frac{.477\,\log\,(1+x)}{\theta^{-1}(1-2n)} = \frac{.477\,(.0086)}{.2164} = .01896.$$

$\therefore 1+p = 1.0445$. *Answer:* The ratio $\frac{209}{200}$ (nearly).

II. One can find the ratio of stimuli at which *any ratio of errors* will occur when the ratio error with a given ratio of stimuli is known, by the following formula:

With the formula $\log\,(1+p) = \dfrac{.477\,\log\,(1+x)}{\theta^{-1}\,(1-2n)}$ find the value of p; then with this value of p and the designated new value of n, find the value of $(1+x)$ by the same formula transposed, viz.

$$\log\,(1+x) = \frac{\log\,(1+p)\,\theta^{-1}(1-2n)}{.477}\,.$$

Example 3.—In Example 1, with what ratio of stimuli

will A make only 7.5 errors in the average set of 100 observations?

We had $p=.032$ or $\log(1+p)=.01377$, and $\theta^{-1}(1-2n)$ will now be equal to $\theta^{-1}(.85)=1.02$.

$$\log(1+x)=\frac{(.01377)(1.02)}{.477}=.0295, \text{ and } (1+x)=1.07.$$

Answer: 1.07.

III. One can also find the ratio of error at *any* ratio of stimuli when the ratio of error with one ratio of stimuli is given, by the following formula. Find $\log(1+p)$ as before. Then find n in the following formula where $(1+x)$ represents the new ratio of stimuli,

$$n=\frac{1-\theta\left\{\dfrac{.477\log(1+x)}{\log(1+p)}\right\}}{2}$$

Example 4.—Find the ratio of wrong answers in Example 1 when the ratio of stimuli is 1.1.

We have $\log(1+p)=.01377$; $\log(1+x)=\log(1.1)=.0414$. Hence

$$n=\frac{1-\theta\left\{\dfrac{.477\log(1+x)}{\log(1+p)}\right\}}{2}=\frac{1-\theta\left\{\dfrac{(.477)(.0414)}{.01377}\right\}}{2}$$

$$=\frac{1-\theta(1.43)}{2}=\frac{1-.956736}{2}=.021632.$$

Answer: 2.16 errors in 100 answers.

IV. I will also show how a practical threshold can be obtained if desired.

Example 5.—Taking the practical threshold at one error in 100 answers and the probable error within its extreme limits in the case of the writer in the experiments on pressure above referred to, viz. .05 and .016, at what ratio will this threshold occur?

$$\log(1+x)=\frac{\log(1+p)\,\theta^{-1}(1-2n)}{.477},$$

$\log(1.05)=.0212$; $\log(1.016)=.00689$;
$\theta^{-1}(1-2n)=\theta^{-1}(.98)=1.649$,

$$\log(1+x)=\frac{(.0212)(1.649)}{.477}=.07333;\ \therefore\ (1+x)=1.184,$$

$$\log(1+x)=\frac{(.00689)(1.649)}{.477}=.02383;\ \therefore(1+x)=1.056.$$

Answer: 100 ounces and 105.6 ounces in the first case; 100 and 118.4 ounces in the second case.

Table of θt from $t=0$, to $t=3.0$.

t	Θt	t	Θt	t	Θt	t	Θt
0.00	0.00000	.2	.22270	1.3	.93401	2.4	.99931
.01	.01128	.3	.32863	1.4	.95229	2.5	.99959
.02	.02256	.4	.42839	1.5	.96611	2.6	.99976
.03	.03384	.5	.52050	1.6	.97625	2.7	.99986
.04	.04511	.6	.60386	1.7	.98379	2.8	.99992
.05	.05637	.7	.67780	1.8	.98909	2.9	.99996
.06	.06762	.8	.74210	1.9	.99279	3.0	.99998
.07	.07886	.9	.79691	2.0	.99532	∞	1.00000
.08	.09008	1.0	.84270	2.1	.99702		
.09	.10128	1.1	.88020	2.2	.99814		
.1	.11246	1.2	.91031	2.3	.99886		

Note.—Intermediate values in this table are derived by interpolation in the ordinary way.

Appendix D.

Rules for Computing the Probable Error.

These rules I take from Jevons, Principles of Science, p. 387.

1. "Draw the mean of all the observed results.

2. Find the excess or defect, that is, the error in each result from the mean.

3. Square each of these reputed errors.

4. Add together all these squares of the errors, which are of course all positive.

5. Divide by one less than the number of observations. This gives the *square of the mean error.*

6. Take the square root of the last result; it is the *mean error of a single observation.*

7. Divide now by the square root of the number of observations, and we get the *mean error of the mean result.*

8. Lastly, multiply by the natural constant 0.6745 (or approximately by 0.674, or even by $\frac{2}{3}$), and we arrive at the *probable error of the mean result.*"

For illustrations of this process and methods for shortening the work see Jevons and works on "Probabilities" there referred to.

It is generally advisable to divide up the observations, and find the probable error of each group and then draw a mean. It is also sometimes desirable to be able to test how closely the number of errors of each degree of deviation from the mean follows the number assigned by the probability curve. Mr. Francis Galton gives an admirable account of this in an appendix to his "Hereditary Genius," to which the reader is referred.

PSYCHOLOGICAL LITERATURE.

I.—EXPERIMENTAL PSYCHOLOGY.

Zur Psychophysik des Lichtsinns. Von HJALMAR NEIGLICK. Philosophische Studien, IV, 1, pp. 28–112.

This is a continuation of the experimental study begun by Dr. Lehmann in the former number of the *Studien.* The method used is that of the "mean gradations," and consists in rapidly rotating three discs, each containing a certain amount of black and white, so that in rotating a uniform gray of a lighter or darker tint is produced, and in requiring the observer to regulate the amount of black on one of these discs so that it shall produce a gray exactly intermediate between the constant grays of the darker and the lighter discs. If the amount of black on the adjustable disc proves to be the *mean proportional* between that on the light and that on the dark disc, Weber's law holds.

Lehmann's elaborate study brought out the many sources of error in this experiment, and above all, the enormous effect of the contrast of the disc with its background. It was found best to set each disc against a background of its own tint; this can readily be done for the two constant discs, but seems difficult to do for the medium disc without giving the observer a clue as to the tint he ought to choose. Neiglick solved this problem by having the background itself a disc much larger than the one to be adjusted, but similarly marked as to white and black, so that when both rotate on a common axis, the adjustable disc, like the others, is seen against its own background. With all these precautions it was found that in a general way Weber's law held, and seemed to hold the more rigidly the more carefully the experiment was conducted. But a new result, on which Professor Wundt, in a note to this article, lays much stress, is that the absolute difference in grayness between the extreme discs affects the validity of the law: in other words, while the mean proportional between x and y is $\sqrt{xy}$, and the mean proportional between $\frac{1}{2}x$ and $2y$ is also $\sqrt{xy}$, yet, as a fact, the adjustment of the one pair will be nearer the mean proportional than that of the other pair. And the difference between the discs in which the law has its greatest validity corresponds to that relation of the tints of the two discs at which the researches of Lehmann showed that the maximum amount of mutual contrast occurs. For example, a setting in which the one disc is entirely white and the other 40° of black is one of the relations at which the law most closely holds. An interesting discussion of the bearing of the phenomena of contrast on Weber's law closes the article.

Two remarks may be added to the account of this research: the first is that it proves the extreme intricacy of this psychophysical method, and yields an excellent instance of the way in which side effects can entirely distort the law of a series of phenomena; the

second remark is that, important as these results are, the author has no right to subject one to the reading of 84 pages to winnow them out. This lengthiness is a fault common to many of the studies from the Leipzig laboratory. J. J.

Zur Theorie der Gesichtsempfindungen. Von J. v. KRIES. Arch. f. Anat. u. Physiol., 1887, p. 113.

In a paper published in 1878 Kries stated a law of physiological optics, that lights composed of different colors which seemed alike to the unfatigued or neutral eye seemed alike also to the eye however fatigued, and two years ago he was led to conclude from further experiments that if the physiological effect of two objectively different light-mixtures was identical, the identity remained if the intensity of the lights was increased or diminished in the same ratio. The first of these laws was new, and the second perhaps implied in the broader law of Grassmann and Helmholtz that lights that appear equal give mixtures that appear equal, but has been more recently questioned. More recent experiments by Hering confirm both laws. From the first law Kries has developed an objection to Hering's theory of visual sensation as follows: A light composed of red and green may seem to an unfatigued eye identical with a light composed of yellow and blue. If the eye be now fatigued; *e. g.* for red, the first light ought on Hering's theory to seem greenish on account of the change in his red-green visual substance, while the other light which did not affect this substance would remain unchanged. The two mixtures, however, do remain the same. Hering accordingly modifies his theory, or, as he says, the statement of it, as follows: We must conceive, he tells us, that yellow and blue light are not without effect on the red-green visual substance and *vice versa*, but represent stimuli of dissimulation and assimulation of equal strength. In other words, he adds to his theory the conception that a light may have at the same time on the same substance two opposite effects, and that these effects must be equally intense for all five of his valences. This v. Kries thinks extremely artificial and improbable, as much so as if two chemically distinct substances should give exactly the same spectrum. With more than three components it requires improbable and *ad hoc* assumptions to explain the facts. Again, if a blue and a white light seem equally bright, they cease to do so if the intensity of both is increased in equal relation. This simple fact, says v. Kries, is absolutely irreconcilable with Hering's theory. So is the fact lately placed beyond all doubt by König and Dieterici, that those that are born color-blind fall naturally into two great groups, the red and green blind. Thus the Young-Helmholtz demarkation of components is again confirmed. The advantage of the latter theory is that it apprehends the effects of light so nearly as they are known in photo-chemistry. Since the discovery of the chemical effects of light on the retina, the conception of different substances in the retina has gained ground, and also that their decompositions represent the components of the Young-Helmholtz theory. The fact that the sensations of heat and cold, once thought to represent two opposite processes in the same nerve, is now known by the discovery made independently by Dr. Donaldson in the psycho-physic rooms of this University and by Dr. Goldsheider, now of Berlin, that these two sensations have distinct nerves and terminal organs, destroys the only analogy that supported the theory of Hering, which will be quite abandoned.

Der entoptische Inhalt des Auges und das entoptische Sehfeld beim hallucinatorischen Sehen. Prof. J. HOPPE. Allg. Zeitschr. f. Psychiatrie, Jan. 1887.

The author rejects the theory of centrally initiated and centrifugally projected hallucinations or pseudo-hallucinations in the sense advocated by Kandinsky, and repudiates the term "reflex hallucination" on the ground that hallucination implies consciousness and reflex action excludes it. Hallucinations are defined as involuntary perceptions constructed from internal stimulus of the sensory nerves. This stimulation may be spontaneous by chemical, mechanical, vasomotor, trophic, or muscular action, may depend on the action of subcortical centres, on the entrance of already acquired concepts into the centre, or on the perceptive activity of consciousness. The material of hallucination is the excitation of the peripheral end of the nerves of sense. On falling asleep by day, Professor Hoppe has a sense of growing pressure between his fingers, as if holding a cigar, so vividly that he often looks to see if it is there, and with closed eyes often seems to see it. This spontaneously aroused sense of pressure is the material of hallucination. Sleeping with arm hanging down from a sofa, as the blood pressure increases and the hand seems to close more tightly, the sense of holding a rod becomes so vivid that only the eye can dissipate the hallucination. In the eye nothing in front of the retina can justly be received as material of hallucination. These, and pressure phosphenes, the images of retinal vessels, zigzag figures, the phenomena of contrast and physiological color sensations, are rather to be called illusions. But the pupil, if it be visible, blood corpuscles, the pulsation of the central artery, persistent after-images, and subjective phenomena represent material of hallucination. After-images the original of which has escaped us, and which we may later remember to have seen. But if we cannot do so, the act of perception is the same as if the real objects were before us. Although the entoptic material of the eye is transformed in an hallucinatory sense. Many forms emerge from the macula lutea in entoptic seeing with closed eye, suggesting that it is a seat of memory for images that reach it from without. The writer has repeatedly discovered, after special search in his environment, the originals of strange forms that first entered his consciousness as after-images, but had themselves passed unobserved. Memory consists largely of persistent after-images, and if it is a function of all nervous tissue, may be in part located in the retina, and thus the questionable hypothesis of excentric projection from the cortex be obviated. A long and minute description of the sequence of images, discs, cubes, sand, raindrops, carpet patterns waved by the pulse, clouds that become ships, fields of corn, trees, etc., as observed by the author in his eyes, pronounced normal by an expert ophthalmologist, follows. These are ascribed to circulatory and nutritive processes in the retina, which are also in this case material of hallucination.

Gegenbemerkung "eine neue Urtheilstäuschung im Gebiete des Gesichtssinnes" betreffend. SIGM. EXNER. Pflüger's Archiv, 1887, p. 776.

Three years ago Exner described the following striking phenomena: On an extended background of uniform brilliancy a small field of different hue but of about the same brightness is superposed. If the brightness of the background is changed by a flickering of the source of light, it is the small field, which is really constantly illum-

inated, that seems to flicker, and the larger background appears unchanged. In a longer article in the same *Archiv*, 1886, Hering savagely criticises Exner's phenomena as not new and not illusions of judgment but of sensation, and intimates that Exner has not taken the trouble to study his views, but follows Helmholtz blindly. Exner replies that he himself discovered independently and in another way the central element of Hering's theory of contrast, the influence of one part of the retina by another. While in general a believer in Hering's contrast theory, he finds it inadequate to the explanation of many details.

Handbuch der physiologischen Optik. H. VON HELMHOLTZ. 1886.

The first three *Lieferungen* of an entirely revised edition of this great classical work are received. The first edition, which has long been out of print, was a work of amazing experimental and literary industry and acumen. In the wellnigh a quarter of a century which has elapsed since its appearance, so much work has been done in this field that a thorough revision of it to the end will involve much labor and be of correspondingly great value. We trust nothing will interfere with its completion.

The Dreams of the Blind. By JOSEPH JASTROW, Ph. D. New Princeton Review, January, 1888.

As long ago as 1838 Dr. G. Heermann published an exceedingly valuable study on this subject, concluding from a broad induction that those who lost sight before the age of from five to seven years do not in adult life continue to dream in visual terms as those do who lose sight after this critical period. He also concluded that deafness carried mutism with it before but not after this same period, which was also critical for dream memory of lost limbs. Dr. Jastrow here takes up the general subject on the basis of an examination of nearly 200 blind persons, and while in general confirming Heermann's results, modifies them in essential details and adds much new material in an article of value and interest and with a wide range of suggestive allusion and literary reference. From 100 answers to the question "What is your earliest remembrance of yourself?" Dr. Jastrow found the average age to go back to 5.2 years. At about this age he says there is a declaration of independence of the sense centres from their food supply of sensations. Thus it can no longer be said that when a sense organ is totally destroyed the ideas received by that organ perish too. The writer believes the blind on the whole to dream less than the seeing, but that females dream more than males. Dreams decline from childhood to age, and those of the blind are most likely to be in terms of hearing.

The Writings of Laura Bridgman. By E. C. SANFORD, Fellow of the Johns Hopkins University. Two articles reprinted from the Overland Monthly, 1887.

The valuable reports of Dr. Howe during the most interesting stages of the education of this famous blind deaf-mute are out of print, and Mrs. Lamson did not utilize for her biography the very voluminous journals kept by Laura herself during this period, which Mr. Sanford here has for the first time read through and subjects to a careful analysis which abounds in valuable material too detailed

to be described here. The impressions of the house, furniture, her family, the domestic animals, the family grindstone, the occupations of those about her, her own amusements and childish escapades, impressions of death, etc., all received through the sense of touch alone, and remembered most of them for many years till she learned to write and recorded them, show how independent of language of any sort all the fundamental psychic processes may be. So too the record of the daily events of her life at the Institute, which at certain periods is very full, her so-called poems, her religious impressions, etc., all bear at every point the marks of her defects both in the nature of her impressions and in the structure of her sentences and often her words, but also marvellous success in overcoming these disadvantages. Into Mr. Sanford's analysis of her graphic, syntactical, stylistic and perceptive errors we cannot enter here.

Ueber die optische Inversion ebener Linearzeichnungen bei einäugiger Betrachtung. Von Dr. J. Loeb. Pflüger's Archiv, 1887, p. 274.

An optical figure composed of seven straight lines may look like the contour of an open book and inclined at about the angle at which it would be held in reading, or by optical inversion its middle angle or edge may appear convex to the observer. Loeb tested children of from seven to fourteen years of age, who were told to hold a book as the figure looked to them, and found increasing the distance of the figure excited the concave, diminishing it, the convex, sensation. Absolute distance had nothing to do with the sensation. Even the movement of a pencil, which was not fixated but held between the eye and the drawing, from or to the former caused concave or convex sensations respectively. Slight movements of convergence are commonly associated with convex, and of divergence with concave sensations. Passive movement of the bulbus sometimes caused convergence. Monocular inversion Loeb thinks due to the innervation which changes the fixation point along the line of vision. The same rules hold of all figures susceptible of inversion.

Ueber einseitigen und doppelseitigen Lidschluss. Von O. Langendorff. Arch. f. Anat. u. Physiol., 1887, p. 144.

In man reflex, as distinct from voluntary, winking is always on both sides, but with the rabbit only the lid of the stimulated side winks. The visual field is less identified with the danger field in the rabbit, the eyes of which are on different sides of the head and have different fields, and which needs a strong stimulus to cause bilateral winking. Exactly the same law in man and in rabbits holds of the perfect reflex. Knoll could observe no sympathy of the unstimulated pupil. But it is rare that the voluntary shutting of one eye in man is so well learned that no tremor of the other lid can be observed, and the feeling is that this is due to antagonistic effect rather than to genuine inhibition.

Die Wahrnehmung der Schallrichtung mittelst der Bogengänge. Von W. Preyer. Arch. f. Physiol., 1887, Heft 11 and 12.

To determine how accurately the direction of a short sharp sound could be located with closed eyes and motionless head it was first

needful to determine fixed points in space which could be re-located with accuracy. This was done by means of a wire cap with 26 wires projecting at regular and equal angles in all directions from a point in the head about midway between tympana of the two ears. Each of these directions was carefully named, and to aid in their mental imagery for the subject of experimentation sticks were stuck in a billet of wood in the same directions, and solid wooden figures were made with a side to the plane of which each stick would be vertical. Each time there are thus of course 25 wrong guesses possible, or in all 650 errors. It was found, however, after many thousand experiments, that right and left were very rarely confused, location in the median plane was quite accurately determined, and when errors occurred here neither right nor left ever had preponderance. It was in this plane, however, that the greatest errors, sometimes amounting to 180°, occurred in judging locations front and back. The number and size of errors in the right and left field were surprisingly alike. Preyer assumes that the nerves of each ampulla have a specific energy of localization in space peculiar to themselves. Thus the horizontal canal is strongest stimulated by sounds in the horizontal plane, the upper vertical or anterior by sounds from front and above, and the lower vertical or posterior by sounds from behind and below—each according to its position in the head. That canal is strongest stimulated with the plane of which the direction of the sound (whether through the air and meatus, etc., or through the bones of the skull) makes the smallest angle. These sounds are confused when coming from positions where this angle is nearly alike for two canals. This in general the experiments confirm, although a few positions resist this interpretation. With one ear closed, feeble sounds far over into the field of the closed ear seemed on the side of the open one.

Ueber die Schrift von Schallbewegungen. Von Prof. HENSEN. Zeitschrift f. Biologie, 1886, Heft 3.

Professor Hensen's logograph (Sprachzeichner), the older form of which was described by Grützner in his *Physiologie der Sprache*, has been much improved upon by Hensen of late, and can now be had of his mechanic (Zwickert, Dänische Strasse, Kiel). It now represents better than has ever been done before the impulses which speech imparts to the ear. The curves are very small, but uniform for different pitches, and made by a membrane rigid enough to check after vibrations. That fine curves only a few hundredths of a millimetre long may be made legible and reproducible, it was necessary to warm the glass plate and smoke it over a gas jet so that the coat of soot upon it could just be seen. The mechanical difficulties encountered were great and have occupied Hensen off and on for fifteen years, but now are so far overcome that a pupil of his, Dr. Paul Wendeler, has graphically reproduced a number of consonant sounds with this apparatus, which are described and presented in magnified form in an article following the above. This apparatus seems at least to have one advantage over attempts to write directly from the tympanum or from artificial tympana, or over all such results as Fick has just described (Betrachtungen über den Mechanismus des Paukenfells, Verhandl. d. med. Gesellsch., Würzburg, 1886), in that its *eigenton* is mainly eliminated.

Ueber einige Veränderungen welche Gehörshallucinationen unter dem Einflusse des galvanischen Stromes erleiden. Von Franz Fischer. Arch. f. Psychiatrie, 1887, p. 75.

Jolly, Erlenmeyer and others have recorded cases in which electrical stimulation of the acusticus caused, not a simple sensation of sound, but an auditory hallucination which Jolly thought to be reflex. Since then a closer relationship than was before suspected is held to exist between noises in the ear and auditory hallucinations. Fischer here describes two noteworthy cases in which the galvanic current applied to the central organs caused a change which favored the cessation of auditory hallucinations. The intensification of these hallucinations by chewing, by food (which was therefore refused), the amelioration of them by stopping the ears, the hyperkusia that attended their intensification, and the auditory obtuseness that marked their decline, all point to the same close relationship. Galvanization, it is inferred, however, intensifies psychic excitation unless it is applied when it has already begun to abate, when it is beneficial.

Experimentelle Untersuchungen zur Physiologie des Geruchs. Von Ed. Aronsohn. Archiv f. Anatomie u. Physiologie, III u. IV Heft, 1886, pp. 321–57.

These experiments were made under the direction of Professor Kronecker, and seem well calculated to allay the unusual distrust so commonly felt for subjective sensations in this particular field. On the basis of the old experiments of Tourtual and E. H. Weber, most text-books in physiology state that only gases and vapors, and not fluids, brought into contact with the olfactory organs, can excite the sense of smell. Solutions of salt, wormwood, dilute sulphuric acid, and cologne had been introduced into the nasal cavity. Valentin, and still more recently Vintschgau, after further experimentation, also reached the conclusion that only substances suspended in the air could be smelled. Yet the olfactory organs are covered by a layer of mucous secretion. The common view that fish not only have olfactory organs but use them was further tested by the author as follows: Ant eggs, a favorite food of gold fish, were saturated with clove oil or asafœtida and thrown into a tank, and approached but refused without being touched within several millimetres by the fish. By using a ⊥ tube the author introduced into his own nose solutions of camphor, clove oil, cologne and other substances, with special precaution to avoid injurious degrees of concentration and temperature, and found them distinctly odorous for some time and in more than 100 experiments. A temperature of 40°–44° C. gave best results. Such statements as Kant's, that "smell is taste acting at a distance," or Cloquet's, that "smell is to air as gustatory solutions are to fluids," must therefore stand corrected.

By further experiments it was found that a rinsing solution of about 0.73 per cent solution of salt was most favorable as an indifferent fluid to keep the function of the olfactory organs intact. Reckoning from this as a basis or unity, solutions of other salts of equally favorable degree of concentration were carefully determined and named "osmoteric equivalents." Thus salt has the smallest osmoteric equivalent of the chief fluids of the body. Of the other elements of blood serum, bicarbonate of soda has an osmoteric

equivalent of 2, sulphate of soda 4, phosphate of soda and magnesium sulphate 6. The sensory effects of mixtures of these salt solutions can be correctly calculated on the bases of these equivalents. They have thus their own smell, though they have before been considered odorless.

With the kathode in the nose the author had a distinct sensation of smell in opening an electric circuit, and with the anode in the nose by closing it. In opposition to Bidder it was also found that fragrant substances taken into the mouth and expelled through the choana were distinctly smelled, and it is inferred with Paulsen that the exspiratory and inspiratory current of air take substantially the same course through the nose. Fatigue soon blunts and almost arrests the sense of smell, but it fully recovers its degree of sensitiveness, but not its power of endurance, in a few minutes. Entire exhaustion from one odor leaves the organs of smell with maximal sensitiveness for other odors. Thus the law of specific energy seems to hold for various olfactory fibres or systems of fibres. This fact would seem to give a method by which the much disputed problem of a classification of smells could be solved. But it is needful that experiments be made with chemical substances of known composition. Chemists differ widely respecting the smell of some even of the more common objects, and of many others the text-books do not state whether they smell or not. Only four elements, chlorine, bromine, iodine, and phosphorus, smell. These seem to the author to be odorless in a pure state, and he concludes that all elements are odorless. There are few more vague terms in the psychology of sensation than those designating odorous qualities, and the need of a more chemically scientific nomenclature is greatly felt. Smells were located by the author and others whom he tested not in but before the nose. One of his subjects had a very vivid dream of experimenting with camphor which seemed to be very distinctly smelled. The author finally queries whether the movement of many odorous substances on the surface of water is connected with the ciliary epithelium which Waldeyer lately found over the olfactory region. It seems especially to be hoped that the capacities of the fatigue method of classifying odors will soon be more fully tested.

Note on the Specific Energy of the Nerves of Taste. Studies from the Biological Laboratory of the Johns Hopkins University, Vol. IV, No. I. By W. H. Howell, Ph. D., and J. H. Kastle, S. B.

A chemically pure substance, named para-brom-benzoic sulphinide $\left(\text{formula } C_6H_8Br \begin{cases} CO \\ SO_2 \end{cases} > NH\right)$, first made in the chemical laboratory of this University, and a derivative of the new substitute for sugar called saccharine, was found to cause very intense and pure gustatory sensations of bitter when applied to the back part of the tongue (region of the circumvallate papillae) and a sweet taste when applied to the tip and borders of the anterior half of the tongue. The latter sensation was much feebler, sometimes reported as slightly acid or metallic sweet or slightly astringent. In a few of the twenty persons tested the sensation on the lip was at first slightly bitter, then sweet, which does not accord with the reaction time experiments of Vintschgau, which showed sweet much quicker than bitter. Saccharine itself on the back of the tongue caused in some persons a rapid alternation of the sensations of sweet and

bitter, like rivalry of the two fields of vision. That a chemically pure substance arouses different taste sensations (and those more purely gustatory than acid and salt) favors the doctrine that each taste sensation has its own specifically energized set of nerve fibres.

Die Methode der Aequivalente angewandt zur Maassbestimmung der Feinheit des Raumsinnes. Von Dr. W. CAMERER. Zeitschrift f. Biologie, 1886, pp. 509–559.

The chief object of this "method of aequivalents" (first used by Weber) is to ascertain the relative sensibility of different parts of the sensory surface. Dr. Camerer contributes a very extensive though somewhat unsatisfactory series of observations on the "space sense" of the skin as tested by this method. For example, he places the compass points 4 lines apart (1 line=2.256 mm.) on the forehead, and then finds how far apart the points of a second compass must be to produce a sensation of equal aperture on the lips, and finds it 2.4 lines, *i. e.* the "aequalization ratio" of the forehead to the lips is $\frac{4}{2.4} = 1.67$.

The application of the line is always closely successive, and the variations caused by beginning with an aperture too wide and gradually narrowing, or reversing this proceeding; by applying the "constant" compass first or last; by varying the absolute distance between the compass points, are all worked out in detail. It is also evident that a constant as well as a variable error will come into play. The following table summarizes the results of the first portion of his experiments:

Constant Distances.	1st Series. Forehead to Lip.	2d Series. Forehead to Wrist.	4th Series. Palm to Forehead.	5th Series. Palm to Forehead.	Mean of 4th and 5th Series.	Constant Distances.	3d Series. Forehead to Finger Tip.
4 Lines.	1.668	1.0165	0.972	——	——	0.5	1.051
8 "	1.353	0.9763	1.043	0.982	1.012	1.0	1.055
12 "			1.048	0.996	1.022	1.5	1.044
16 "			1.037	0.989	1.013	2.0	1.033
20 "			1.016	0.985	1.000	2.5	1.028
24 "			1.032	1.003	1.017	3.0	1.025

Each ratio is based upon 240 observations, and the distances were always applied transversely. An important result is that the ratio is affected by the absolute size of the distance applied, the ratio approaching unity as the distance increases.

Many irregularities occur; while in the 4th series the forehead has a finer sensibility than the palm, in the fifth series this is reversed. It is also to be noticed that this method does not show nearly as great differences between the severable parts of the skin as Weber does with the method of "just observable differences."

The individual differences of the four observers who were tested were slight; the effect of practice was quite marked, as shown by a decrease of the aequalization ratio; and the average deviation (variable error) was about 8.5 per cent (in Series 1), it being considerably smaller in the larger distances than in the shorter ones.

A few other questions that were asked were these:

(1) If I have the aequalization ratio of the wrist to the forehead and also of the forehead to the lip, by multiplying the two will I get the same ratio for the sensibility of the wrist to the lip as I would by actual experiment? For the instance just noted this is found to hold, the calculated ratio being 1.4012 and the observed 1.3814. A similar comparison of the wrist, palm, and finger-tip, however, gave a discordant result.

(2) It was found that the sensibility near the median line of a limb or part of the body was very slightly superior to the lateral regions immediately next to it as well as to those farther removed.

(3) On the palm this method, that of the "right and wrong cases," and that of the "just observable difference," were applied to the relative sensibility of the longitudinal to the transverse axis, and all three agreed in making the transverse axis somewhat superior.

Dr. Camerer concludes that the reliability of the method is not clearly made out, and that the assumption of certain constants is necessary to account for the discrepancies to which it leads. An attempt is also made to bring the results into connection with the recent views of Goldscheider, but here again agreement is impossible. The facts must be accepted as such for the present, and their explanation be postponed until more is known of this ever widening field of research. J. J.

Untersuchungen über den Fühlraum der Hand. Erste Mittheilung. Von Dr. J. Loeb. Arch. f. die Ges. Physiol., September, 1887.

With body fixed, all points touchable by the point of the index finger of a freely movable hand and arm are called, in imitation of Hering's optical nomenclature, the *tactile space* of the hand. The rectilinear distance between any two points in this hemispherical space is called the *tactile tract*. The *nuclear point* is, arbitrarily chosen, determined as the point in the median plane (between the tactile spaces of the two hands) where the index fingers meet when the upper arm is adducted and the elbows flexed at right angles. In the first series of experiments a horizontal thread was stretched through the nuclear point, and grasped at that point with thumb and finger of each hand. At a signal both hands moved symmetrically out with closed eyes and as nearly equal rate as possible till halt was called. The distance traversed by each hand was measured in experiments on about 30 persons. Each person was found to have a preferred hand which went always farther than the other, the difference being from one tenth to one half the entire tactile tract, and often with an apparent maximum at 150–200 mm. from the nuclear point, from which the experimenters always tried to keep the distance constantly equal for both hands. If one hand was moved passively, neither the sense nor the constancy of the result was affected, yet the tactile tract of the moved hand was very slightly increased. Knowledge of the constant error he was making on the part of the experimenter had only a temporary effect in correcting it. In hospital patients with unilateral defect the asymmetry was greatly increased. When both hands moved at the same time in the same direction the medial tract was always considerably greater than the lateral, but the over-estimation of the medial tract diminishes very rapidly when one hand passes over into the tactile space of the other. When one tract was marked off and felt, and another to be moved over judged to be equal to it, the reproduced

tract was constantly greater or less in different persons with little reference to the position of the pattern line or its direction. The chief ground of judging the distance traversed by the hand is the time occupied by the motion; to judge differentially of rapidity requires much practice. This appeared in testing Vierordt's statement that a point drawn across the hand seemed smaller the more rapidly it was moved, and by drawing threads and wires with different rapidities between the thumbs and fingers of passive hands. Thus if the duration of the impulse and of the movement is the same, rapidity is generally neglected. Equal volitional impulses give rise to the impression of equal rapidity.

Substantially all these results and others were obtained by a different method, which makes the long discussion that closes this article unnecessary, as long ago as early in 1882, and published in the English quarterly journal, *Mind*, by G. Stanley Hall and E. M. Hartwell, under the title *Bilateral Asymmetry of Function*. These observers also showed that the eyes follow the same asymmetric tendency; that there is a constant error, which was measured, in attempting to bring the index fingers into the position which is designated by Loeb as the nuclear point; that there is a constant asymmetry in reaction time, in maximal clenching movements, etc.

Untersuchungen über die Wärmestrahlung des menschlichen Körpers. Von A. Masje. Virchow's Archiv, January and February, 1887.

These extended and valuable researches were made in Zürich, and in part under the direction of Prof. H. Eichorst, and embrace the study of heat radiation in both normal and morbid, especially fever, states, but later pathological studies are yet to be described in detail. The formula of Dulong and Petit, that the heat radiating from a body is proportional to the fourth power of its absolute temperature, does not apply to living bodies, which lack a constant constitution internally and superficially. All formulae agree in making radiation decrease with decrease of heat for constant conditions with lifeless bodies, while for the human body, especially in fever where anti-febrile medicines are used, radiation of heat increases as the body cools. All previous studies, from Scharling in 1849 to d'Arsonval in 1885, followed the same method. A naked man was placed in a receptacle in a room of constant temperature, and after a given time the difference of temperature between the receptacle and the room was made the basis of calculation. This, however, does not show the normal, but rather the artificial loss of heat. The method used by Masje was to allow the heat from any exposed part of the body to radiate through a closed card-box, to avoid air movements, upon a fine metallic electric conductor, whereby its resistance is changed proportionally to the elevation of the temperature. Another equilibrating conductor also, of long strips of tin foil on gutta percha, is used, and between the two is a galvanometer. When the two conductors are at constant temperature and a current is allowed to pass through them, the effect of the two can be so exactly balanced by a rheochord that no deviation of the mirror of the galvanometer is observed. But if one is exposed to the radiant heat of the hand, the resulting difference of temperature in the conductors is very accurately recorded by the galvanometer in excursions directly proportional to the heat absorbed by the conductors. By this method the following results were reached. After uncovering

a part of the body usually covered, the radiation of heat from it increases, not always constantly, but with variations, and this increase is more rapid if the surrounding temperature is low. Parts normally uncovered, as the hand and face, radiate heat about uniformly all times of day. Under the same meteorological conditions of atmospheric humidity and barometric state, radiation in the same person varies from day to day, as does the relative radiation from different parts of the body. Radiation is least on parts of the body covered with hair; it is more on flexor than on extensor sides of the limbs, especially the arms; on symmetrical points it varies but little in adults, but sometimes much in children; the average radiation from covered parts is less in women than in men. Extensive tables of the amount of radiation from equal surfaces of different parts of the body are given. A moderately cold or warm bath increases radiation afterward, as well as after exercise or friction. After the inward use of antipyretics, radiation increases as the bodily temperature sinks. The author believes the cause for increase and decrease of radiation is to be sought in a change of the physical and chemical constitution of tissues which is under the control of the nervous system.

Einfluss des Nervensystems auf die thierische Temperatur. Von Dr. UGOLINO MOSSO. Virchow's Archiv, October, 1886.

This prize thesis, by a young brother of the well known physiologist of Turin, is a résumé of a more extended paper published in Italian. The valuable work of Heidenhain in 1884 presents the history of the conclusion now so fundamental in physiology, that muscle contraction develops heat. It is only bad batteries, however, that do so. If it could be shown that heat continues to be developed after the muscle has ceased to contract, that the increase of heat is not proportional to the work, that by the constant contraction of a muscle the temperature of an organism cannot be increased, and that the temperature of the body may diminish while the muscular work remains the same, then it may be inferred that heat production is an attendant but not necessary phenomenon of contraction. The first of the above statements was proven by stimulating reflex frogs, from the thighs of which calorimetric readings were taken. Dogs were allowed to run inside wheels six metres in circumference for six hours, and rectal measurements of temperature showed, after a rapid rise for the first hour, a gradual sinking for the following five hours, reaching the intermediate point between extremes of temperature at the beginning and end of the first hour, and at rest sinking rapidly below the former. The temperature of Dr. Mosso's body during a two days' march was not in relation to the work done. Again, strychnine increases the temperature of the animal body, even after it has fallen through the influence of curara, and in spite of the most complete immobility of the muscles. In dogs the rectal increase thus obtained is as much as three degrees. Of the three places, brain, sinus, and rectum, where measurements were taken, which were about alike, the sinus temperature always decreased with muscle work. In experimenting with drugs causing convulsions, temperature always increased before cramps, and the blood temperature in the right sinus often fell during cramps. In curarized animals a rapid and lasting elevation of temperature was observed as a result of the infliction of pain.

Similar elevation of temperature was observed in man as a result of pain, but here the conditions were more complicated. The rectal temperature of dogs, which is very susceptible of variation, rose sharply at sound of a gun, and still more from the emotions connected with bringing them from the cool cellar, where they spent the night, into the laboratory, and also on seeing other dogs. Emotion also increased the temperature of pigeons. A strong emotion of joy caused in the author an increase of temperature amounting to nearly a degree, which had only sunk to half a degree four hours later.

Four Cerebral Heat-Centres. By ISAAC OTT, M. D., and WILLIAM S. CARTER. Therapeutic Gazette, Sept. 15, 1887.

In previously published results Dr. Ott claims to have shown that fever is mainly a disease of the nervous centres; that albumoses, peptones, the leucomaine neurine, produce fever through the nervous system; that antipyretics produce fever by acting on it, and that the ascription of fever, sleep, and the action of peripheral irritants to modifications of circulation is entirely erroneous. In this article he attempts to define more minutely the heat centres which he claims to have been the first to discover about the corpus striatum. The method was calorimetric observations on trephined rabbits. Four centres are found: 1, in front of and beneath the corpus striatum; 2, on the median side of the nodus curiosius; 3, the parts about Schiff's crying centre; 4, the anterior inner end of the optic thalamus. The last causes the highest rise of temperature, but the elevation caused by 2 and 3 lasts longer, sometimes more than three days. These centres have excitory and inhibitory power. Respiratory and circulatory changes attending puncture have no thermal effect. Puncture may either remove their inhibition on the spinal thermogenic centres, or cause them to act with these as exciting centres in exciting increased chemical metamorphosis of tissue. In an earlier article (*Journal of Nervous and Mental Diseases*, July, 1887) Dr. Ott claims to have shown that the thermo-inhibitory fibres decussate at the nib of the calamus, and in still another, this indefatigable experimenter (all in his private laboratory at Easton, Pa.) has explored the relation of the thermogenetic apparatus to atropine (*Therapeutic Gazette*, August, 1887).

Reactionszeiten der Temperatur-Empfindungen. Von GOLDSCHEIDER. Berlin. Physiolog. Gesellschaft, June, 1887.

A suspended metallic ball was so hung that displacement of it involved the breaking of an electric circuit for chronological measurement. The stimulus was made with closed eyes and by active motions of the person stimulated, and upon many different dermal points. The chief results were that temperature sensations come to consciousness later than those of contact, that cold is perceived much sooner than heat (15° C. and 50° C.), and that this difference increased with the distance from the brain, till it reached the relatively enormous amount of about half a second. With feebler degrees of thermal stimulation both the average and personal errors increased, as did the time. Still greater retardation of sensation from heat has been observed (Stern–Oppenheim) in tabes. Goldscheider does not think this difference between warm and cold due to different centripetal paths nor to difference in peripheral stimulation. The cause is not yet apparent.

Zur Physiologie des Geschlechtsapparates des Frosches. Von Prof. J. K. TARCHANOFF. Pflüger's Archiv, 1887, pp. 320–351.

Spallanzani and Goltz had found that the sexual embrace lasted from four to ten days till the last egg had appeared and been fructified, and that not only the strong fore legs and thumbs of the male, which were so firmly locked together that they could not be parted without lesion, but the whole nervous and muscular apparatus of embrace was in a state of strong and constant tonic excitation. Decapitation nor burning did not interrupt, nor burning nor abscission of limbs of the male prevent a renewal of the act. To answer the question, what is the impulse that proceeds from the female and what is the seat of excitation in the male, Goltz removed the ovaries, cord and brain and skin along the back of the female without lessening the ardor of the embrace by the male, which, however, refused a male sewed into the skin of a female, and concluded that every part of the female had a certain attraction. The various senses of the male were successively eliminated, and the conclusion reached that the attraction affected its every sensory apparatus. The reflex mechanism of the embrace was found to be located in the upper part of the cord, and to be excited from the skin between the fore legs, and after decapitation the finger of a man is clasped as tightly as the female with intact brain, but if this skin is removed the embrace no longer takes place. Castration did not affect the passion of the male nor even relax his embrace, but spots were found on the skin where the application of acids relaxed the embrace of the reflex frog. After repeating and confirming these experiments, Tarchanoff cut out the various internal organs of the male, including testes, one after another during the embrace without relaxing it. Only the emptying or excision of the seminal vesicle caused voluntary relaxation and lasting sexual indifference of the male. The same result followed section of the nerves connecting these vesicles with the central nervous system. Relaxation of the embrace by inhibition caused by painful reagents is far easier near its beginning than near its end, and with intact than with excised brain. Stimuli of the thalami or anterior portions of the corpora bigemina are especially effective in relaxing the embrace. This inhibition, the author inclines to think, is direct.

Ein gekreuzter Reflex beim Frosche. Von O. LANGENDORFF. Arch. f. Anat. u. Physiol., 1887, p. 141.

If a frog is held in the hand so that its hind legs hang down loosely, and the skin near the eye or tympanum be stroked with a blunt instrument, the leg on the opposite side is strongly flexed and abducted, and the web between the toes unfolded. The movement is tetanic, and continues some time after the stimulus is removed. This reflex, not provided for by Pflüger's laws, succeeds on nearly every frog, and even if the hemispheres and mid-brain are removed, but is inhibited by strong sensory stimulation on the same side. With electrical stimulation, when the kathode is applied to one and the anode to the other side of the head, the experiment succeeds also, but best of all with contra-lateral tetanizing induction currents. The crossing must take place beneath the medulla, but in what region of the cord it is not determined.

Myographische Versuche am lebenden Menschen. Von A. Fick. Arch. f. d. Ges. Physiol., September, 1887.

Change of tension in muscles so disposed that their length cannot vary is called isomeric contraction, and an apparatus devised by Fick to show this change of tension is called a tension indicator. The extended hand was laid in a simple frame with the palm or surface vertical, the thumb directed upwards with its ball resting against a solid wooden surface, and the index finger, to the second joint of which the indicator was attached, in a horizontal direction. The changes of length were of course not absolutely excluded, but were registered, greatly magnified, by a very long lever. Electrical stimulus was applied to the abductor indicis. Thus it was possible to reckon what Weber called the "absolute muscular power," or the direct pull of the muscle on that part of the bone leverage to which it is attached, which is a magnitude of the same order as that which Koster by another method determined for the muscles of the calf of the leg. No endurable degree and no frequency of electric stimulus can excite the same degree of tension as the will, but only at most about two thirds as much. A tetanus can develop from six to ten times as great tension as a single shock. While a frog's muscle of about the same size develops great energy of contraction from a single shock, a series of tetanizing shocks can hardly develop double the energy of one. The voluntary and electrical stimulus summate, but the greater the voluntary tension the less is the additional tension caused by electricity. The interval of time between the individual shocks is within wide limits indifferent. Besides this increased tension the electric stimulus there is a later reflex diminution of the voluntary tension. If the latter was maximal, only the reflex effect is seen on the indicator.

Ueber Ataxie und Muskelsinn. Goldscheider. Verhandlungen der Physiol. Gesellsch., Berlin, August, 1887.

Dr. Goldscheider reports experiments which favor the Leyden theory of spinal ataxia (which ascribes it to lesions of sensory tracts), as opposed to the theory of Erb and Friedreich (which ascribes it to centrifugally conducting co-ordination fibres). As both parties admit that in rare cases there may be extended and absolute anæsthesia produced without ataxia, as well as ataxia without disorders of sensibility, the question really focuses down to the problem of the muscle sense. To test this he rested the hand in a plaster mould, palm upward, and bent the index finger back by changing pressure of a small weight, measuring carefully the least angular bending at the first joint which could be perceived. A faradic current was then applied over the joint which caused nearly complete anæsthesia, when it was found that the finger joint must be bent far more to be perceived than before. Thus centripetal impressions from the nerves of the joint seem to be an element in the perception of passive movement. If active movements are attempted by a finger thus faradized, they can no longer be made continuously, but are intermittent, as well as excessive and more rapid, in other words ataxic, while the subject believes the movements to be uniform. With strong currents the graphic representation of both flexion and extension is like stairs. If the eye and attention are turned to the finger, the amplitude and rapidity of motion are reduced to the normal, but the intermittence can be but slightly

reduced. This phenomenon is ascribed to a reduction of sensation for changes of position. The greatly increased threshold value of the stimulus of co-ordinating the action of antagonistic muscles is the closing explanatory suggestion.

Ueber Unterscheidungszeiten. J. v. KRIES. Vierteljahrschrift f. Wiss. Philos., January, 1887.

According to Wundt, perception is the entrance of a conception into the inner field of vision, and apperception is its entrance into the inner point of vision; and he ascribes a distinct element of a total reaction time to the interval between these two processes. v. Kries doubts the wisdom of thus introducing figurative expressions which are not immediately intelligible into the description of psychic processes, and thinks that this formulation of Wundt runs some risk of overlooking important things and confusing different ones. It inclines uncritical minds to think that each concept, a certain time after it enters the field of mental vision, passes on to the focus of attention, and that thus apperception time of *e. g.* a complex object is always a quite definite time. v. Kries therefore prefers the term differentiation time, first used by him in 1877, because the different qualities of the same object are known in quite different times depending on the direction of attention, etc. In these earlier experiments the task for the experimenter was to give all his attention to determining whether a signal had a certain quality (*e. g.* was red or not), which is quite different from recognizing which of several colors appeared. Again, the so-called *c*-method of Donders requires simply reaction on *a* and not to *b*, and is not to be confounded, as Wundt does, with a choice between motion and rest. v. Kries's experiments involve only mental differentiation, and his results, such as that localization is quicker than judgment of intensity, optic direction than distance, and acoustic localization time increases with decrease of the angle of divergence, are not to be brought under Wundt's rubrics. Wundt's method of reacting after the judgment is made that perception has taken place, introduces an element of introspection which is too variable to give precise results. Differentiation time proper is here at least increased by a value of unknown magnitude, and it is impossible to exclude cases in which the impulse to reaction precedes knowledge. In such a series of psychic processes it is impossible to bring the reaction always at one and the same stage of each series, as much so as it would be to react at either the optic or the acoustic sensation of an electric spark at will. Results by Wundt's method are therefore doubted. Either the reaction is too quick, or else reflection time is added. Of Wundt's pupils, all have found, therefore, too long reaction times, and one of them, Cattell, even intimates that v. Kries not only often reacted prematurely, but often suppressed results, in one series in fact more than half of all. This v. Kries indignantly denies, and repeated his former experiments only to find them correct.

Kritisches und Experimentelles über den Zeitsinn. Von RICHARD GLASS. Philosophische Studien, IV, Heft 3, pp. 423-457.

The fact that in the sphere of the time sense, more than elsewhere, the conclusions of different observers stand in glaring contradiction to one another, induced the author to attempt to add his contribution to the topic. He follows in the footsteps of Estel and

Mehner, and used the same instrument, the essential parts of which consist in a device for marking off the standard time by the interval between two electric clicks, and for measuring the time between the last of these clicks and the stoppage of the apparatus, the latter being the time that the subject regards as equal to the first interval. Vierordt had found that small intervals are over-estimated, large ones under-estimated, an indifference point (where the estimate is correct) intervening. Estel found that at the multiples of the time at which this indifference point occurred there were likewise maxima of accuracy of judgment; he also concluded that Weber's law was not applicable to the time sense. Mehner's results are, that these maxima of accuracy occur only at the *odd* multiples of the indifference time (.71 sec.), the minima of accuracy occurring at the even multiples, up to about 11.4 sec. Furthermore, that intervals up to .7 sec. were exaggerated; intervals from .7 sec. to 5 sec. were under-estimated, and larger intervals again exaggerated. The author subjects these results to a rigorous criticism, the outcome of which is that a harmony in the results can be brought about only by not working the results for more than they are worth, and by taking into account the method, the unavoidable individual differences, and the rough and unusual sense exercise that is employed.

His own results are as follows: The standard times in the first series were the multiples of .7 (in the main) up to 15 sec.; and 100 observations on each time were made. He finds that points of greatest accuracy are at 2.8, 7.8, 9.3, 12 and 14.2 secs., and of minimum accuracy at 5, 8.5, 10, 12.8 and 15 sec. This does not agree with the periodicity of Mehner, but shows two groups of relative indifference points, each rising by an interval of about 5 sec. (2.8, 7.8, 12), (9.3, 14.2). The result of the second and more extended series is that the difference between the points of greatest accuracy is quite regularly 1.25 sec., with the exception that at .8 sec. there is a point not thus included. The law for the points of least accuracy cannot be traced. If we take into account that all the judgments are too long because they include parts of a reaction time and deduct $\frac{1}{20}$ of a sec. on this score, all the intervals (excepting that at .8) are under-estimated. The general conclusion supports Vierordt and opposes Mehner. Regarding Weber's law the author concludes that while decided deviations from this law occur (some of which can be explained), yet there is a strong tendency to follow the law as closely as the nature of the experiments would lead one to expect.

It will be seen that while this paper forms a real contribution to our knowledge of the time sense, it by no means places this topic in the clear light in which it should stand to gain recognition as a branch of accurate science. J. J.

Beiträge zur Theorie der sinnlichen Aufmerksamkeit und der activen Apperception. Von N. LANGE. Philos. Studien, Bd. 4, Heft 7.

Attention strengthens sensations, so that even very weak ones may eclipse in consciousness those objectively far stronger. But for this specific power, present sensations would expel concepts, memory, etc., because the former are more intense. Attention, however, is no extraneous power. It is a name for the process of reinforcing one set of impressions by another set. In attention the will does not work directly on concepts. The will must not be divided into motive and

apperceptive will, and it cannot inhibit concepts. This whole problem has grown in importance with the decline of the English theory of association, and the latter is due to the neglect of the phenomena of active apperception. Very feeble sensations strongly attended to alternately vanish and grow intense. The duration of the periodic wave of attention can thus be measured. Helmholtz had noticed this vacillation of unusual optical impressions in experiments with Masson's discs, and Urbantschitsch had noticed a similar phenomenon in the ticking of a watch not due to objective variation or to peripheral organs, but to central changes in attention. It is observed in cases of perforated tympanum, and so cannot be due to periodic tension of entotic muscles. That this is not due to the fatigue of the acoustic nerve, as Urbantschitsch thought, is shown by the fact that when the phenomenon is observed for both optical and acoustic sensations simultaneously, the two periodicities of the two series of sensations do not coincide, but are separated by a fixed interval. Thus the cause cannot lie in independent peripheral organs, but must lie in a common centre. Lange was able to register these vacillations of intensity chronoscopically, not only for one, but for two kinds of sensation simultaneously. These periods are longest for sound (3.5 to 4 seconds), next longest for light (3 to 3.4 seconds), and shortest for faint electrical stimuli (2.5 to 2.6 seconds). The average variation was less than one fourth of the entire period.

De la Répartition du Sang circulant dans l'Encéphale. Expériences faites au laboratoire de physiologie de l'Université de Bruxelles. E. Spehl. L'Encéphale, 1887, Vol. I.

The old theory that the brain was congested in sleep was first effectively combatted by Durham in 1860. Since then the anaemic state of the cortex has been experimentally proven in four ways: 1. By experimentation on animals by Claude Bernard, Weir Mitchell, and others; 2. A little later, by observations of the movements of contraction and expansion in patients who have lost a part of the skull; 3. By observations on the same class of patients by the more precise graphic method—last and chiefest by Mosso; 4. A method preferred by Hammond, of ophthalmoscopic observation of the retina as reflecting the vascular state of the brain. The method of Spehl was to apply about the neck of a rabbit an apparatus by which all connection between the head and trunk could be instantly arrested and decapitation be then carefully made. Five animals in the normal condition were subjected to this treatment, and the weight of the whole body and that of the quantity of blood in the head and trunk carefully determined. Five more were treated then in the same way in a state of sleep induced by chloral, and the results compared. The average proportion of blood in the head in the latter series had sunk from one eighth to more than one eleventh, confirming thus the general conclusion that in sleep the brain as a whole is anaemic. The mode of experiment does not of course admit of discrimination between the quantity of blood in the head and in the brain only, and the inference from sleep produced by normal sleep to the hypnotism of chloral is obviously only highly probable. The author suggests, in conclusion, that the differences of opinion that have prevailed may be due to the active parts of the brain being congested and inactive parts anaemic at the same time.

II.—HISTOLOGY OF THE NERVOUS SYSTEM.

Ueber den Ursprung und den centralen Verlauf des Nervus Accessorius Willisii. Von Otto Dees, München. Allg. Ztschr. f. Psych., XLIII, 4.

The author studied the origin and central course of the accessory nerve in the normal human cord and in the cords of rabbits in which the nerve had been removed by v. Gudden's method. At the level of the olivary body the accessory fibres cease. Below this they first arise, in the oblongata, from cells in the middle of the anterior horn (superior nucleus). This group of cells becomes more lateral, and between the second and fourth cervical nerves lies on the lateral edge of the anterior horn (the median nucleus), while below this it occupies the base of the lateral horn (inferior nucleus). Certain fibres emerge at the level at which they arise, others run towards the head, then turn at right angles and come to the periphery.

Sulla degenerazioni discendenti consecutive a lesioni sperimentali in diversa zone della corteccia cerebrale. Dei Dot. V. Marchi e G. Algeri. Revista speriment. di freniatria e di medicina leg., 1887, XII, p. 208.

The authors experimented on dogs and monkeys, from which they removed parts of the cortex, and then, having allowed the animals to live months or years, searched the oblongata and cord for degenerations. (1) On three dogs a piece of cortex 1.5 cm. on a side was cut away from the motor region (D. H. C. of Munk's figures). (2) On three more dogs a piece of the same size in the intermediate region (F. of Munk) was removed, and in (3) a final three a portion of the occipital region (A. of Munk). (4) Finally a monkey had the region A on both sides removed, and square piece in the upper third of the central convolutions on both sides. In all series there were motor disturbances—most marked in the first and least so in the last. Sensory disturbances in every case also. These were least marked in the first and most so in the last. The disturbances did not in either case entirely disappear during the time that the animals were allowed to live.

The degenerations found were distributed among motor and sensory tracts in the cord in a way roughly indicated by the reactions of the animals. In 1, degenerations were found in the crossed and uncrossed pyramidal tracts and some fibres in the columns of Burdach. In 2, partial degeneration of the crossed pyramidal tracts, extensive degeneration in both columns of Burdach, and scattered atrophic fibres throughout the entire section of the cord. In 3, the degenerations were as follows: Complete atrophy of the crossed column of Burdach, while the crossed column of Gall and the entire uncrossed posterior column showed only a few degenerated fibres. In 4, the monkey, which was kept alive two years, the entire extent of both post. columns was degenerated, and there were scattered atrophic fibres through all the other parts. It is concluded from these results that sensory and motor fields to a certain extent coincide in the cortex, and that a complete crossing of sensory or motor fibres is not to be assumed.

Zwei Feuerländer Gehirne. Von Dr. JOH. SEITZ, in Zürich. Zeitschrift für Ethnologie, 1886, Heft 6.

One of these Fuegian brains was that of a man, the other of a woman, the respective capacities being 1710 cm^3. and 1370 cm^3. This gives an estimated brain weight of 1631 gr. and 1370 gr. The author concludes, after careful study of them, that "The weight is average and the measurements average. The measurements of the fissure of Rolando are like the European. As regards convolutions and fissures of the cerebrum, the representations of European brains are in all respects applicable to these brains of savages." The author calls attention to the fact that other investigators in this line reaching other conclusions, have often described variations from the ordinary as marks of a low type.

Ueber das Riechcentrum. Eine vergleichend-anatomische Studie. Von Prof. Dr. E. ZUCKERHANDL, in Graz. Stuttgart, 1887.

From a careful comparative study of the callosal convolution (Balkenwindung), first described by the author, and its associated parts, Z. describes the following as the anatomical basis for the sense of smell: 1. Cortical portion: Ventral portion and frontal end of the lob. corp. callosi, lob. hippocampi with the uncus, Ammon's horn with the marginal convolution, cortex of the peduncul. olfactor., of the lam. perforat. anter., and the bulbus olfactorius. 2. Radial fibres: Inner marginal convolution. 3. The union of identical regions in the two hemispheres is effected through the ant. commissure. 4. Association paths: The fibrae propriae of the convolutions named—the forceps and a part of the fornix and alveus.

On the Histology and Function of the Mammalian Superior Cervical Ganglion. By W. HALE WHITE. Journ. of Physiology, 1887, Vol. VIII, No. 2.

To his previous investigations the author has added the study of 41 sup. cerv. ganglia from human adults, 10 from human foetuses, and 46 from the higher mammalia. The results are: 1. In man the ganglion is very variable in size, while in animals it bears a direct relation to the size of the creature. 2. In man there are proportionately more atrophic cells with granular pigment than in other mammalia—monkeys are most similar to man—but these cells disappear as one descends in the animal series. 3. The ganglia in the human foetus show only normal cells. The author concludes that in the adult we have to deal with a stunted organ, and further investigation furnishes grounds for the view that what is true of the sup. cerv. ganglion is true for the entire sympathetic nerve.

Ueber die Bedeutung der Hirnfurchung. Von J. SEITZ, Zürich. Jahrbücher für Psychiatrie, 1887, Bd. VII, Heft 3.

The author looks on the form of the convolutions as something to be explained in the same way that the external form of the species of which they are characteristic is explained. The fissures and furrows are mechanical aids to nutrition. The topography of the brain is influenced by all the causes which influence growth, and the true significance of the convoluting of the surface can only be understood when all these factors are considered.

Sulla fina struttura dei corpi striati e dei talami ottici. Del Dott. V. MARCHI. Revista speriment. di Freniatr. ecc., 1887, XII, p. 285.

The author here presents the results of several years' investigation on the structure of the corpora striata and the optic thalami. The entire investigation is based on Golgi's work. He finds the cells irregularly scattered through both ganglia. Those of Golgi's first type, or the so-called motor, are most abundant in the optic thalami, while those of the second type, or the sensory, are most abundant in the corpora striata. The fibres enter the cells of the first type only. It follows, therefore, that he considers the optic thalami as motor in function, and the corpora striata as sensory.

Ueber den Kernursprung des Augen-Facialis. Von E. MENDEL. Neurologisches Centralblatt, 1887, No. 23.

The author points out that in 90 per cent of the cases of apoplexia sanguinea the mouth-facialis is affected while the eye-facialis is not. That in bulbar paralysis the facial nucleus is found degenerated, and yet the eye-facialis is not affected. He removed in rabbits and guinea pigs, by modification of the method of v. Gudden, the muscles supplied by the eye-facialis on one side. As a result, the posterior part of the oculo-motor nucleus on the same side was found atrophic. The fibres from these cells to the facialis stem run apparently through the posterior longitudinal bundle. The pathological evidence, so far as it exists, favors the location of the eye-facialis in the homologous nucleus in man. It is another example of the central concentration of the nuclei of associated muscles.

Ueber den Ursprung und den centralen Verlauf des Acusticus. Von v. MONAKOW. Correspondenzbl. f. Schweizer Aertzte, 1887, No. 5.

The author made use of v. Gudden's method on cats. As a result of these experiments the probable track of the acusticus fibres from the periphery to the cortex is given as follows: Posterior root, superficial layers of the tuberculum acusticum, striae arcuatae acusticae, fibrae arcuatae crossing in the raphe, dorsal medullary substance of the superior olive, the inferior lemniscus, corpora geniculata interna, posterior bigemina and their arm, temporo-occipital lobe.

H. H. D.

III.—ABNORMAL PSYCHOLOGY.

(1) *Der Traum als Naturnothwendigkeit erklärt.* Von W. ROBERT. Zweite Auflage. Hamburg, 1886. 53 pp.

(2) *Das Leben im Traum.* Eine Studie, von Dr. PAUL SCHWARTZKOPFF. Leipzig, 1887. 102 pp.

(3) *Schlaf und Traum.* Eine populär wissenschaftliche Darstellung, von Dr. FRIEDRICH SCHOLZ. Leipzig, 1887. 70 pp.

(1) Different students, such as Strümpel and Hildebrandt, have noted that the materials of which dream images are made have come either by suggestion of trivial experiences of recent waking life, or are such stimuli incorporated, with little or much modification,

into the dream drama. Robert seeks to make this fact the key to all dreaming, and to explain the phenomena as a necessity for rational psychic life. Whenever we receive an impression we tend to act upon it, to elaborate it as it were, and to appropriate the useful by storing it away in memory. We receive many impressions, some of them of interest, but which we have not time to attend to while we are busied with the daily duties. At night these impressions, thus temporarily set aside, come up, pressing their claims upon us when we have leisure to attend to them. Most of these impressions, together with refuse of ideas digested during the day that lies like chips in our mental workshop, are swept out, chiefly during the early part of sleep. But morning dreams are more elaborate. These work up undigested material which is of use to the psychic economy. In this way does the brain solve our problems for us during sleep. Insanity is simply an overwhelming flood of unarranged ideas, and hence the value of sleep as a restorative to sanity. Robert thinks all attempts to classify dreams are futile. He illustrates his theory by relating and explaining various dreams; also notes dreaming of disease and of drugs.

(2) Our second author emphasizes the idea that we have psychic activity in sleep to such an extent as to make dreams the real life of the soul. In dreams we lose nothing of our character, not one jot of mental power. The flighty, illogical, magical, disconnected and incomplete nature of dreams is due to the fact that a stable world with its continuous stimuli has been shut out from us by the closure of our senses, and the stimuli we do receive come at intervals and in a sudden way, startling us and exciting our emotional nature. The mind, as Lotze says, of its own power creates images when the sign of the stimulus presents itself, and this is in fact the sensation itself. In dreams the mind likewise can create sensations just as real as in waking life, and that whether there be external stimuli or no. Even in waking life we have power to withdraw our attention from external stimuli and in abstraction live. A sensation, a perception or apperception, a representation (memory, fancy, imagination), an hallucination, all are one simple act of mind, but differing in intensity and concomitants; and all these modes we can exercise whether awake or asleep. In waking life we do not recall dreams to any great extent, but likewise in sleep we have forgotten the objective world and our past experiences. All the different gradations of activity felt in dreaming may be experienced while awake. It is all a mental creation like unto that exercised by poets and dramatists. The laws of association obtain in a similar manner in both states of life. Dreaming is a purer activity of mind, and shows its best fruits in the visions of seers and prophets.

(3) Dr. Scholz has given us a very readable brochure covering the entire subject of sleep and dreaming, with a third section on sleeplessness, its causes, and a general consideration of the hygiene of sleep. The standpoint is that of modern physiology; the figure, that of ebb and flow of the tide. In sleep the cerebral activity is at a minimum. Pflüger's theory of sleep, elaborated by Preyer, is adopted as the best theory, though it must be confessed that it does not offer a complete explanation. All activity of protoplasm is accompanied by oxidation—the breaking down of complex molecules that have previously been built up in connection with absorption of oxygen. This absorbed or intramolecular oxygen is, as it were, a granary that furnishes force for the activity of the cell. But when

the cell is active it uses up oxygen faster than it receives it (katabolism overbalances anabolism), hence must come a period of rest from activity where anabolism has the upper hand. During the katabolic process the products of decomposition gather in the cell and clog its activities. Then the cell desires sleep. When the refuse has been cleared away and the waste made good by synthetic processes, the cell once more is ready for work, its protoplasm is irritable and explodes at the first stimulus, the cell awakes. When we transfer this picture to the cells constituting the higher psychic ganglia, and hold that mental activity is accompanied by and dependent on cerebral cell activity, we have a good explanation of the cause and phenomena of sleep. The author then explains the laws of sleep by application of the above hypothesis.

In considering dreams, Radestock is principally followed. The controlling centre being asleep, the lower centres are free to act as they have a chance, and are stimulated to activity either by impressions of the senses, or from the abnormal processes in the body, or lastly, by the spontaneous play of the least tired cerebral cells themselves, recalling memories that have not been in the mind for some time. Much comes from the vast region of the unconscious. In the elaboration of dream images, the laws of association will of course find free play. The attention not being fixed is freer to respond to faint impressions, hence incipient disease in the body is able to arouse prophetic dreams.

No attempt can be made to give a complete abstract of a paper like this, which is itself an abstract well worth reading. J. Nelson.

Zur Pathologie des Gedächtnisses. Von Dr. A. Pick. Arch. f. Psychiatrie, 1886, p. 83.

While partial anmesia, especially in the field of speech, has been carefully studied of late, comparatively little has been added during the last ten years to our knowledge of general anmesia, and the cases that have been studied with detail are mostly progressive and not regressive cases. A married woman of 27 as a sequel of peritonitis quite lost memory of her own name and age, marriage, child, etc. When she came to the asylum at Dobzean, of which the author is the director, she was unable to remember whether she had taken her meals, the day of the week, the year, whether she had ever seen the doctor, etc. Gradually, however, the details of her past life were recalled, recent and remote events revived, and at the end of three months her memory seemed quite normal. Optical memory images seemed most completely extinguished, so that the case may illustrate asymbolism in the changed sense that Wernicke gave to the term as originally suggested by Finkelnburg. In the case of patients who confuse persons and objects, get lost in well known streets, chew coal, exchange ingredients in cooking, loss of memory images is probably the real cause of what is often diagnosed as delusions. In this case the tests by questions, pictures, etc., were very numerous, and the law that the most familiar concepts of daily life were first regained was strikingly illustrated, thus affording the often desiderated complement to the frequent observation that these concepts were the last to be lost in regenerative cases. Koempfen's law that loss of memory proceeds backward in time from the trauma toward childhood, and return of memory is from the remoter past to the present, is also in general well confirmed in this case. But

during the period of convalescence the patient was strongly prone to localize events in time according to their vividness in her memory, indicating weakness of associative processes. The high degree of apathy shown by the patient in the lower stages of her mental obnubilation seems to have been due in part to the general exhaustion which weakened memory also, and also in part to the loss of the stimulus that a regular supply of memory images furnishes. This patient had so much better memory for auditory than for visual images in youth that the period of their return was separated by a marked interval. Loss of memory is so commonly associated with unrecoverable cases, or the restoration of memory, if it occurs, is too sudden to afford opportunity to study its stages, so that altogether this must be called a noteworthy case.

Illustrations of Unconscious Memory in Disease, including a Theory of Alteratives. By CHARLES CREIGHTON, M. D. London, 1886.

This book is a remarkable illustration of interpreting the physiological by the psychological, rather than the reverse, as is more often done, and seems to have been suggested by Hering's lecture on "Memory as a Function of Organized Matter," and by Hartmann's "Unconscious." Consciousness on the one hand and generation on the other represent the extremes of explicit and of implicit memory. Generation is potential, consciousness actual, memory. Every lapse from or retreat behind consciousness represents the tendency to involution toward the above acme of implicitness. Repairs and growth, especially of new tissue after traumatis, are a reminiscence of embryonic activity. The memory of development is concentrated in the ovaries, and ovarian tumors are fantastic and perverted productions. Reproduction is the deepest rooted memory. All diseases, in fact all reminiscences, perverted or not, is of earlier states or experiences of the individual or ancestral organism. A neurotic person, *e. g.*, has a retentive memory. Alteratives are means of habit-breaking. Does not the instinctive doubt which arises as to the soundness of Dr. Creighton's method imply a deep-seated distrust in the normative nature of consciousness?

Remarkable Case of Sudden Loss of Memory: F. P. DAVIES, M. D. (England). Am. Journal of Insanity, April, 1887.

A young man of 22 was brought to an English asylum in July, 1886, who had apparently lost all memory of his own name, friends, or past life. He habitually wore a puzzled look, and spent much time in trying to recall his past life. After a few days he began to have "inspiration." The name of a person he knew came back or was "revealed" to him, and later another; but both these persons when written to denied all knowledge of the man described. He became depressed, and wrote intelligent letters indicating much mental culture, to others, describing himself, but compelled to subscribe himself as "Unknown." His photograph was taken and sent in vain. After about four months it was half believed that he was malingering, and he was put into an unpleasant ward and told he should not leave it till he had ended his game and told his name and address. The next day these came back to him and he wrote letters to his friends and was taken away. His memory now returned rather rapidly. The author was convinced that the loss of memory was genuine, and that it came on during two days of helpless

wandering in an abnormal state in which he was first found by the police. He proved to have been a clerk of ability in a large establishment which he had suddenly left because a demand for more salary was refused, and had disappeared. Was it epilepsy?

Habit in Insanity. By A. B. RICHARDSON, M. D. Am. Journal of Insanity, April, 1887.

The three elements determining habitual discharge of nervous energy are (*a*) congenital disposition; (*b*) experience under external conditions; (*c*) inhibitory and directory power over the will. The latter two can be to a degree controlled. Disease especially, however, weakens the will, and the insane are more imitative than the sane. In the early stages of disease bad habits can be best modified for the better. Even delusions which are often very fixed may be removed or replaced by others less incurable, not by argument, but by environment and treatment. Fixed habits of treatment by physicians are responsible for many bad habits of patients. Habits of taking certain drugs, habits of filth and untidiness, laziness, destructiveness, and even homicidal propensities, may be greatly modified for the better by persevering adaptation of treatment to individual cases, remembering that "our nervous system grows to the modes in which it is exercised." Love of this adaptation and individual study is the best guarantee that a physician is growing in excellence. The writer has tried his method with great success in his own asylum. The patient must be always placed in a position most favorable to reassume sane habits.

Lecture on the Disorders of Language. By Professor BIANCHI, Naples. Alienist and Neurologist, April, 1887.

This article, translated by Dr. Joseph Workman, of Toronto, the well known and still vigorous octogenarian alienist, represents that the four elementary factors of speech (two sensory—hearing and seeing—and two motor—speaking and writing) which have been developed and inter-related in the evolution of speech, connect with functional extrinsication of diverse parts of the brain; writing and reading being of course much later ontogenetically and philogenetically than hearing and speaking. Hearing is located on the first temporal convolution and a part of the second; seeing words in the inferior parietal lobule; speaking in the foot of the left inferior frontal convolution, and writing at the foot of the left second frontal convolution. Each centre is situated within larger related areas, the motor in the wider field of arm or tongue and jaw motions, and the sensory are specialized centres within the field of hearing and sight; and these special as well as the wider general centres are very closely related, so that a disease of one without an affection of others is rare. Each centre, too, is the focus of memory images. Thus one may hear but not know the meaning of words, as is the case with a child. This is the sensory aphasia of Wernicke, or the verbal deafness of Kussmaul, and is often associated with paraphasia. Lichtheim's view that the inner acoustic image, or internal diction, is indispensable to correct pronunciation is refuted by clinical facts. His theory that simple verbal deafness is due to lesion of the centripetal auditive paths before their entrance into the centre, it being sound, is opposed to that of Charcot and Kussmaul, that this may be due to lesion in the acoustic centre, while speaking, reading

and writing may be possible. In cases of pure verbal deafness the acoustic may be represented by the visual image. Bianchi dissents from Charcot's view that verbal deafness and verbal amnesia may have the same seat, but in the first case be destroyed and in the latter only superficially injured, and holds that amnesia may be due to interruption between the idea and acoustic centre, or due to enfeeblement of ideation. Verbal blindness is much less apt to be associated with psychic lesion than verbal deafness, although the latter often co-exists with intact ideative processes. If DeWatteville's view be correct that reading is possible only with true mnemonic and reproduction of acoustic images, then verbal blindness ought to be caused by interruption between the acoustic and visive centre. An interesting case of an aphasic is given who could not get the name "hat" from seeing it or even touching it, but just attained the word by taking the hat and putting it on his head with some force with both hands, and could pronounce the word "key" only in the act of turning a key. Whether this is sensory (Wernicke) or motor aphasia (G. Stewart) it is hard to tell, but the *post mortem* finding did not indicate disease of the word-centre.

On different Kinds of Aphasia, with special Reference to their Classification and ultimate Pathology. By H. C. BASTIAN. pp. 28. 1887.

Fourteen forms of defect in speech and writing are distinguished. The basis is anatomical, and the terms commissural aphasia, glosso- and cheiro-kinaesthetic centre may serve to suggest the chief novelties in this vexed field of classification. The paper contains interesting and new cases and diagrams.

De la Guérison de la Paralysie Générale, et de la Théorie des Pseudo-folies Paralytiques. BAILLARGER. Annales Médico-psychologiques, 1887, No. 1.

General paralysis is so universally held to be incurable that whenever a case of recovery has been reported it is at once set down, obvious and unique as the symptoms are, as a case of error in diagnosis. Even the case of recovery so minutely reported by Tuczek (in his Beiträge zur pathologischen Anatomie und zur Pathologie der Dementia paralytica) has been called an error of this sort. Baillarger, however, here reports a case of a man of thirty-nine who became prodigal in his expenses, excited, sleepless, with delusions of greatness as to his wealth, the number of his children, thought himself Pope and Emperor of Germany, and lost power to articulate certain sounds. About a year after he entered the asylum (1878) he had begun to recover, and at the intercession of his friends was granted leave of absence, the certificate of release stating, however, that he was enjoying a remission, that a fresh attack was certain, and that his intelligence was already greatly enfeebled. He quite recovered, and in 1882 resumed his post of business. Vision, however, was gradually impaired in one eye, and in 1884 symptoms of locomotor ataxia were fully developed. The author objects to the distinction between true general paralysis characterized by chronic periencephalitis, and pseudo-general paralysis due to simple circulatory derangements, and prefers to say that two distinct maladies have been confused under the term of general paralysis: one being characterized by diffuse delirium of greatness, hesitation of speech, and being quite distinct from general paralysis, the early stages of which it resembles, and being, unlike it, curable.

Paralysis, Cerebral, Bulbar, and Spinal. H. C. BASTIAN. London, 1886, pp. 671.

Paralysis is the most pathological of nervous diseases, and the author even goes so far as to state dogmatically that "almost if not quite all paralyses are invariably caused by definite morbid conditions, appreciable by the naked eye or by the microscope, or by both," although this would hardly hold of paralyses of sense nor of functional paralysis of motion, to say the least, both of which are treated in this book. The writer can and does confine himself largely to a basis of nerval and morbid anatomy, but the cuts, which are quite numerous, are mostly old and familiar. The regional diagnosis, to which much space is devoted, is good, but on the whole is written from the standpoint of the physician rather than of the scientific physiologist. The strictly pathological diagnosis is treated best of all, and the many convenient tables constitute probably the chief value of the book. The chapter on disorders of intellectual expression by speech and writing covers but thirty pages, but contains a valuable table for the examination of aphasic and amnesic patients. The chapters on spinal paralyses, in which such remarkable advances have been recently made, are brief, but quite adequate to the needs of the practitioner, whose wants are throughout kept mainly in view. The book is a vast and thoroughly well ordered collection of material, and is, on the whole, even more valuable than the author's previous work on Brain Physiology.

Remarks on Evolution and Dissolution of the Nervous System. J. HUGHLINGS-JACKSON. Journal of Mental Science, April, 1887.

In this valuable article the well known views of the author are summarized and widened. In severe epilepsy crude activities in all parts of the body, and at once, are produced, such a discharging lesion beginning in the latest and highest level of evolution. The post-paroxysmal state is dissolutive, which may reach almost total dementia, which is persisting coma, and recovery from which is re-evolution. There are high, low, and mid-level fits, representing different evolutionary levels. Laryngismus stridulus, *e. g.*, is a low-level, bulbar fit. Even a small and local physiological fulminate, if sudden and rapid enough, may set up discharges in healthy nervous tissue associated collaterally downward, and end in severe convulsion. Among the different insanities, melancholia (posterior lobes?) and general paralysis (anterior lobes?) signify different local dissolutions of the highest centres, as surely as brachioplegia or cruroplegia signify dissolution of middle, or ophthalmoplegia, of the lowest motor centres. In post-epileptic insanity, mania is the outcome of activities on the levels of evolution remaining, and the union of high special action with great defects of consciousness in some of these cases is due to deep dissolution in one hemisphere co-existing with high evolution in the other. Alcoholism on the other hand produces uniform dissolution without the phenomena due to different levels. The level of evolution also varies in different centres, and is a co-factor with the depth of lesion. Positive symptoms, as *e. g.* illusion, are evolutionary on a reduced but then highest level of a nervous system mutilated by disease. The hierarchy of the nervous system, which is throughout a sensory-motor mechanism, is threefold. 1. The lowest level consists of anterior and posterior horns of the spinal cord, Clarke's visceral

column and Stelling's nucleus, and the homologues of these parts higher up. It represents all parts of the body most nearly directly. 2. The middle level consists of Ferrier's motor region with the ganglia of the corpus striatum and of his sensory region, and represents all parts of the body doubly indirectly. 3. The highest level consists of the prae-frontal and occipital lobes, or of the highest motor and sensory centres respectively, these being the organ of mind, and evolved from the middle as the middle are from the lower and the lower from the periphery, and this re-represents the body triply indirectly. The division between the middle and highest is less decided than between the middle and lowest; and the author confesses some doubt at present as to the occipital lobes being the highest sensory centres. These three levels represent progress from homogeneity to heterogeneity, and increasing degrees of differentiation, specialization, integration, and interconnection, which are the four chief factors of organic evolution. The term "indirect" means that in going up the levels there are not insensible gradations but occasional stoppages. The pyramidal tracts, *e. g.*, connect the lower with the middle centres, and thus raise them to much higher powers. Centres are both reservoirs and resistances, and it is these latter or protective activities that make the physical basis between faint and vivid states of consciousness. Trains of thought, or internal evolution, independent of present experience, can go on. High centres are most complex, least organized, most needing to be forced into activity, but more capable of new kinds of action. Inward and upward the sensory centres are overcome in order, and finally great irradiation in the highest sensory centres occurs, and a "survival of the fittest" states. Downward there is a narrowing of the energy of liberation, as the possible is made actual. *Les grand maux* differs from *les petits maux* in that in the former the middle centres offer less resistance. The highest centres are least automatic, most imperfectly reflex, and seats of most active evolution, and universally representative of the whole organism and all its processes. It is the physical basis of the ego which is co-ordination or representation, the two latter terms being taken as equivalent. To understand the brain we must not take "a too brutally materialistic view" of the mind. Between mental and cerebral states there is perfect concomitance, not identity. Darwinism does not imply materialism, and this "two clock theory" is "convenient in the study of nervous diseases." The author does not attempt to explain mental states, but the structure of the brain, and, which is greater, what parts of the body it represents, and how to identify the two, is a metaphysical way of making short work of a hard problem. The chief use of mental symptoms for the physician is as signs of what is going on or ought to in high centres. The conception of concomitance rejects such terms as emotional or volitional centres, ideo-motor physiology of mind as logical cross-divisions, and declines to say the mind influences the body, fright makes the heart beat, or that sensations, ideas, etc., produce movements. Such expressions imply disbelief in the doctrine of the conservation of energy. Movements always arise from liberation of energy in the outer world, and it would be strange if an immaterial will interfered with the activity of nervous arrangements of the highest centres. On the concomitance theory we should not say an act was not done from lack of will, an aphasic did not speak because he had lost the memory of words, or a comatose patient did not move because he was

unconscious, but should try to find materialistic explanations of physical inabilities. As to how far down in the higher nerve centres consciousness attends nervous action, whether we judge by elaborateness of action or by memory as necessary, it is impossible to tell by loss of consciousness just how far down the lesion has extended. But as evolution proceeds consciousness is raised higher, and in dissolution activities on lower levels may have attendant states of consciousness. A typical fit of epilepsy is analyzed to illustrate the author's view so far, a scheme of future work is presented, in which constant reference must be had to the evolution of higher from lower, *e. g.*, as follows: 1. Centres for simplest movements of limbs become evolved in the highest centres into the physical bases of volition. 2. Centres for simple reflex action of hands and eyes evolve into the physical bases of visual and tactile ideas. 3. Centres for tongue, palate and lips, as concerned in eating and swallowing, became bases of words as symbols of abstract reasoning. 4. Lower circulatory centres became the bases of emotions. Thus the highest evolved from the lower becomes independent of it, and is the emotional basis of mind. Three degrees of post-epileptic insanity correspond to three depths of exhaustion. Even after a very slight fit there is defect of consciousness as to present surroundings with increase of consciousness as to some earlier surroundings, thus occasioning what often seems like two different mental states. Progressive muscular atrophy, paralysis agitans, and general paralyses of the insane, are alike in being due to decay of cells in order of size from small to large, but unlike in occurring on the lowest, middle and highest levels respectively of motor evolution.

Some of the Relationships between Epilepsy and Insanity. By Dr. C. H. Savage. Brain, January, 1887, pp. 446–56.

Under the treatment of Hughlings-Jackson, who, in his epoch-making work on epilepsy, took the first important step towards applying the philosophy of evolution as represented by Herbert Spencer to the psychology of mental diseases (cf. the remarkable way in which, before and after Griesinger, Herbartian conceptions dominated the field of morbid psychology in Germany), this disease has come to be of the utmost interest to psycho-physicists. Dr. Savage, whose little book on "Insanity and Allied Neuroses," gives evidence of unusual discrimination, breadth and independence, here suggests two classes of epileptics: first the neurotic, with inherited nervous instability, and second, the organic or accidental, due to definite lesions in the brain itself. He thinks "masked epilepsy" rarely occurs without being preceded by fits; of which violent, acute and repeated dreams, occurrences that cannot be accounted for, or gaps in life that cannot be quite filled by the patient, are ample evidence. He suggests that those who are epileptic by heredity may be able to bear more nervous disturbance than those of apparently good stock, and thinks that the study of chronic epileptics may be as useful to the philosopher as the weathering of the rocks to the geologist. Singular cases where epilepsy serves to restore mental balance, the outbreak of severe fits coincides with the cure of even chronic insanity, are given. It is suggested that there may also be some relation between hallucination of smell, so very common in epilepsy, and the prevalence of the same delusion in those who are insane with

sexual disorders. As to the rate and direction of destruction of the mind in epilepsy (which after all is only provisionally a "disease," rather than a group of symptoms which happen to occur together, often under very various conditions), Dr. Savage thinks that either memory may be chiefly affected, when dementia may supervene in extreme cases, or that loss of control, more liable in furious cases, may be caused, when mania may result. Severe fits at long intervals are less degenerative than slight ones following each other at frequent intervals, for the latter preclude the possibility of the accumulation of energy, drawing it off as fast as it is stored. The other relations, lightly touched on, between muscular and psychic automatism in the status epilepticus are of great interest to the psychologist.

Der Verlauf der Psychosen. Von R. ARNDT, Professor der Psychiatrie an der Universität Greifswald, und Dr. A. DOHM. Wien, 1887, pp. 48.

In Arndt's *Lehrbuch für Psychologie*, 1883, an attempt, too little noted, had been made to reduce psychoses to the more scientific laws of nervous excitation and muscle contraction as demonstrated in experimental physiology. This, it was said, brought forms of psychoses, commonly regarded as remote, near together, and gave a new and transparent basis of classification. Psychoses are no longer diseases, but symptoms, like pain, cramp, etc. Instead of regarding melancholy, *e. g.*, as a state of depression and mania as a state of exaltation, each is conceived as an hyperaesthesia or hyperthymia, occasioned in the former case by a depressed and in the latter case by an exalted ego. Melancholy is thus widely distinguished from stupor, with which it is often too closely associated in classification, and furor may be melancholic or maniacal. In place of the ever growing complexity of psychiatric classification, Arndt would group all forms of psychoses about the fundamental laws, that feeble stimuli arouse nervous activity, medium stimuli increase it, strong inhibit, and very strong destroy it. Fourteen colored tables, representing as many typical cases from the insane asylum at Greifswald, are presented graphically to illustrate the above principles according to a method first presented by Dohm, the other author, in an inaugural dissertation in 1885. In these ingenious tables an ideal or indifference line represents repose or normal poise. From this horizontal middle line, a curve representing departures from this state is either upward toward mania or downward toward melancholia. To a certain extent up or down these fluctuations of "ergasia" are still within the latitude or tropics of health. Departure beyond these limits either way has seven degrees up or down, expressed by moods or acts of increasing abnormality, and culminating both ways in unconscious acts explosive (as distinct from impulsive) in their character. The aesthesias or "modifications of feeling or self-consciousness," are divided into ten forms, and are represented by hatched and cross-hatched lines constituting the background of the curve. Finally, paraesthesias are on violet; hypochondrial cases on brown; hysterical on green; alcoholic on blue, and epileptic on red background. Color in the last four cases shows thus the constitutional anomaly on the basis of which the psychosis is unfolded. The significance of the hatching is thus explained. Every form of self-expression is reflex. If sensations are retarded and inhibited, as they are especially liable to be in hyperaesthesic

states, so that their reflex effects do not readily flow off in the motor, secretory or trophic regions, a sense of psychalgia or melancholia results; conversely, if the system is less sensitive, and stimuli pass to their reflex effects without inhibition or with loss tension, feelings of pleasure tending towards mania arise, and the consciousness of the ego is exalted.

Chorea und Psychose. Dr. Schuchardt. Allg. Zeitschr. f. Psychiatrie, January, 1887.

After an extended and valuable sketch of the history of medical opinion concerning chorea, in which it is shown that the St. Vitus Dance of the Middle Ages, or chorea magna, is more nearly allied to hysteria than to true chorea, and that there is a widely extended opinion among writers upon chorea that it is closely allied with forms of psychic disturbance, Dr. Schuchardt describes six new cases, and concludes that the choreic type of psychosis is characterized by intense irritability and a strong inclination to quite sudden outbreaks of violence. The alien movements are often the first symptoms of impending psychic dissolution. It is now quite well established that the seat of pure chorea is in the brain, and chiefly in the grey substance of both the basal ganglia and the cortex. Its contagious nature by imitation, the close relation between motion and sensation generally, Meynert's conception of chorea as a convulsive phenomenon of irradiation of the fore-brain, the fact that choreic movements desist in sleep and are increased by mental excitement and by passion and fright, all indicate its close affinity with psychic processes. Congruent groups of muscles must constrict distinctly and in definite order if co-ordinated motions are to be produced. If the excentric impulse from the volition centres finds this plexus or series of associated constrictions broken up or inverted or unevenly interrupted, and the symptoms of chorea are present, and causes or is the concomitant of dissolutive, degenerative symptoms in the psychic zones.

Dichterische Einbildungskraft und Wahnsinn. Prof. Dilthey. Leipzig, 1886, pp. 30.

The author opposes the commonly asserted kinship between genius and insanity. They are as unlike as the heat from healthy play or superfluous vitality and the heat of disease. A genius differs from common men in having more energy, in taking greater pleasure in his mental processes, is not pathological, but a perfect or superior type of man. His reciprocity with his environment is closer, his mental images, though vivid, numerous and spontaneous, as is shown by the interesting accounts of their mental processes given by several authors quoted, are especially distinguished, even in geniuses of the most demonic type, by being in closer and more logical relations with the environment and with each other.

Konrad Deubler. Von A. Dodel-Port. 1886.

This remarkable work, in two large volumes, consists of day-book, biography, and correspondence of an Austrian peasant-philosopher. The son of a miner, apprenticed to a miller, later a baker, innkeeper, guide, and peasant, engaged all his life in hard manual labor and suffering manifold afflictions and indignities, he gradually,

by his own almost unaided and unschooled efforts, wrought his way to learning, gathered a library of his own slender earnings, attained singular beauty and independence of character, came into correspondence with many learned men. Engaged in pondering the highest themes while occupied with the lowliest duties, there is much in his opinions and traits which suggests Epictetus and Boehme. His portrait in steel is prefixed.

Die Bedeutung der Mimik für Diagnose des Irrseins. Von Professor LIKONSKY. Neurolog. Centralblatt, October 15 and November 1, 1887.

Two kinds of mimetic movements of the insane are distinguished, expressions of changed consciousness, and especially self-feeling, and abnormalities of facial innervation which have nothing to do with mimesis. In melancholia attonita the lower facial muscles are relaxed and the face seems prolonged. The corners of the mouth are drawn down. Horizontal wrinkles extend often entirely across the forehead. The mouth is shortened horizontally and slightly open. The muscles become fixed as a mask, and from contraction cease to express emotional character. In excitement they respond to emotional change very slowly. In mania the "muscular insanity" of the limbs is seen in typical cases as grimaces that do not express the emotions they would normally indicate. General excitement is also expressed in tensions that multiply wrinkles and sharpen the features. The expression of opposite emotions at the same time by different features is typical. In secondary apathetic dementia the face is smooth and expressionless, save the corrugation caused by the m. frontalis, which retains its emotional excitability longer than all others. In secondary dementia and verrüktheit there is much in common. Most interesting, however, is the mimesis of degenerative states. Here three types are distinguished: (*a*) Great preponderance of the muscles of the forehead over those of the lower part of the face. Sometimes all nuances of emotion are expressed by the frontal muscle alone in multiplying and deepening both vertical and horizontal corrugations. In other cases this muscle habitually expresses concentrated attention or meditation. (*b*) The upper lip is enlarged and is the centre of emotional expression, the excitement passing easily into irregular choreic movements. (*c*) The muscles involved in smiling may be the centre of excitement, and then those involved in sneering and crying are often involved, so that the laughter is convulsive and pathological. The eyes often sparkle, but the joy expressed seems painful. Duchenne's charts show that this involves different muscles from those involved in laughter mingled with sadness in normal cases. In all these cases the mimetic change is primary, so that emotions, even though unchanged, must work upon a changed mechanism. The mimesis is independent of will and consciousness. Relaxation and isolated partial changes in the muscular innervation of the face are also observed. After these higher psychic functions are weakened, the play of emotional expression on the face becomes more free, sharp, and intense. Mimesis of an undifferentiated character, and that involving the thick upper lip alone, are especially common among the savages, and may be called devolutive in the insane. These symptoms may be brought into relation with other expressive movements and have high diagnostic and prognostic

value. Finally, this fact is mentioned: Years ago the writer practiced constricting his facial muscles singly before a glass. He found the left side of his face most expressive and also most educable, and could do much with these muscles that he could not with those of the right side. Resuming these practices after years of intermission, he found to his surprise that he could now subject the right side to his will in what he could not do before, quite as well as the left. These isolated constrictions are possible on the lower part of the face only unilaterally, and cannot be accomplished bilaterally. Freusberg's account of anomalous movements in simple psychoses (Arch. f. Psych., Bd. XVII) and Dr. Ziehen's more special article (Berliner Klin. Wochenschr. 1887, No. 26) cover somewhat different ground, although more closely related to this work than any other recent studies, so that Likonsky's observations are to some extent novel, and it is hoped may suggest further work in the same direction.

Arrested and Aberrant Development of Fissures and Gyres in the Brains of Paranoiacs, Criminals, Idiots, and Negroes. C. K. MILLS. Journal of Nervous and Mental Disease, September and October, 1886.

This valuable article, in the form of the presidential address of the American Neurological Association, designates the marks of cortical conformation of low type as follows: Simplicity of structure, with well defined and little complicated fissures and gyres, especially the frontal; atypical asymmetry and unusual symmetry; distinctness of Benedikt's external orbital fissure; partial or complete uncovering of the insula; absence of sinuosity in the central fissure, and imperfect demarcation from the sagittal and sylvian fissures; confluence of the central fissure above, below or lateral, and perhaps confluence generally; sharp, long, unabridged parietal fissure; small marginal gyre; elongated retrocentral fissure; an occipital fissure open in the lateral surface, with the superior pli de passage below the brain level; great length of the posterior vertical arm of the supertemporal or parallel fissure, with tendency to confluence with the sylvian, occipital or parietal fissure; smallness of paracentral lobuli and precuneus, and universal destruction of the median portion of the occipital fissure. Interesting specimens are shown. There is no criminal type of brain, for crimes are of most diverse character and from opposite motives, and at least such a type if it existed would be clearly allied to the types found in idiots, inebriates, and paranoiacs. Whether fissuration be due to mechanical causes or represent lines of retarded growth, each fissure is probably not due to a distinct process, but is in many cases, as Dr. A. J. Parker had shown, due to "vegetative repetition." If thus some fissures are secondary, it is idle to seek homologues for each fissure, even in closely related brains. Dr. Mills concludes by reminding us that it is not by the study of fissures and gyres alone that the whole truth can be determined, but the depth of fissure, thickness of gray matter, quality of tissue, weights, difference in ventricles, capsules, corpus callosum, etc., should be studied and compared, and such patient work would be of great value and would yield sure results to the patient student.

Change in the Composition and Function of the Brain by Psychic Influence. By F. Richter. Berliner Klin. Wochenschrift, February, 1887.

The stimulus of normal psychic activities, which it is the object of psychic therapeutics to apply, may be so devised as to be a powerful auxiliary, though always subordinate to diatetic and physical means in curing certain brain diseases. This is especially the case in disturbances originating in shock, overwork, care, sorrow, losses, bad habits, and false education. All forms of psychic shock cause first local anaemia of the brain with probably less hyperaemia in adjacent regions. Cohnheim and Arndt hold (and the former claims to have experimentally demonstrated it) that repeated stimuli cause contraction of capillaries, and that if this has lasted long its cessation leaves the porosity of the capillary walls impaired so that the blood elements too freely saturate the brain and thus impair its functions. This unequal distribution of blood affects the vaso-motor sphere in turn, and arterial pressure and transudation and imbibition ensue. Arndt believes that the ganglion bodies thus tend to lose their processes, become apolar and even indistinguishable from adjacent nervous tissue, although, as Richter suggests, this begins to look like the results of inflammation. Such changes are ascribed to abnormal or excessive psychic stimulus, and the symptoms which attend them resemble those which follow cerebral neuroses of anaemic and dyscrasic origin, and may be attended by hemianaesthesia, neuralgia, exhaustion, lameness, cramp, aphasia, cardiac neuroses, nervous catarrh of nose, stomach, intestines, nervous metritis, irritability, depression, etc. But mental hygiene, wisely directed, has a regenerative influence. A deranged cortex with false psychic functions may have its abnormal tissue or compounds degenerated or decomposed by wise psychic regime. Morbid inhibitory stimuli may be neutralized by normal stimuli. For abulia with consequent lameness, excitement of the will is prescribed. Paralyses from fright are redressed by new psychic shock. The greatest tact is of course needed in such cases to hit the right nuance between sedative and stimulating influences and decide on just the right psychic state to neutralize the morbid one. The greatest personal ascendancy over the will and even imagination of the patient, and with of course isolation from too tender friends, is indispensable. Narrow-mindedness, conceit, stubbornness, and in fact pure psychoses generally, are harder to deal with than neuroses with psychopathic symptoms, and require ascendancy over the mind of the patient and an ability to impose a good psychic sphere, which makes the highest degree of confidence on the part of the patient absolutely indispensable. The weak point of this paper is the absence of indirect proof (direct being of course out of the question) of the underlying assumption of positive regeneration or "Rückbildung" of cell processes or other brain tissue.

On Changes in the Nervous System after Amputation of Limbs, with Bibliography and Recent Cases. E. S. Reynolds. Brain, January, 1887.

The conclusions of this valuable and comprehensive paper are that the numerous small fibres of the sciatic trunk after amputation are results of atrophy and not degeneration. This is ascribed to disuse only, connection with the trophic centres preventing degenerative

change. Most of them are demonstrably sensory and could be traced through the posterior spinal ganglia to the cord, but some are as certainly motor. Afferent impulses from parts removed are of course impossible, but motor impulses overflowing from the cord to stumps, though only to be blocked at the site of amputation, are at least conceivable. The small fibres caused by general paralysis must be distinguished from Ranvier's small fibres constituting the neuroma and occurring at the end of the central stump of a cut nerve. The postero-lateral group is not sensory, but motor, innervating the muscles which maintain the erect position. Affection of the sensory tracts reduced the size of the posterior column and horn of the same side, but Clarke's columns were intact, their function being, as Gaskel has almost conclusively shown, the innervation of the viscera. All shrinking due to amputation is compensated by great widening of the lymph channels and slight increase of connective tissue in the small bundles.

Ueber Koprostasic-Reflex Neurosis. By Prof. E. H. KISCH. Berlin. Klin. Wochenschr., April, 1887.

Neuroses of the heart are the most common of the reflex neuroses, which the author thinks to be due to habitual constipation. Next in order of frequency follow hemicrania. Then come sciatica, lumbar-abdominal neuralgia, ovaralgia, and the trigeminal neuralgia of Gussenbauer. The author feels justified in designating these as a distinct group of neuralgic affections due to defective action of intestinal ganglia, or in the terms in which Nothnagel summarized the results of his investigations, to "a diminution of the automatic activity of the nervous apparatus of the intestines."

Ueber die posthemiplegischen Bewegungsstörungen. Eine klinische Studie. B. GREIDENBERG. Arch. f. Psychiatrie, 1886, p. 131.

This extended study, with very copious use of the literature of the subject collected in 267 titles at the end, in this new and fruitful field, is too crowded with details to be adequately reviewed. The main result reached by the author, not only from the literature but from careful study of cases, is expressed in the following table classifying post-hemiplegic movements :

- Contractures
  - apoplectic, cramps,
    - tonic
    - clonic
    - intermittent
  - muscular rigidity
  - early — paralytic, passive
  - late
    - constant, lasting, fixed
    - changeable, (latent)
- exaltation of tendon reflexes
- co-ordinate movements
- tremors — Composite forms in various combinations.
  - reflex, clonus
  - essential
    - trembling proper (tremor) in the form of paralysis agitans or of disseminate sclerosis
- hemichorea — Composite forms in various combinations.
  - constant
  - with intended movements, disturbance of co-ordination (hemi-ataxia)
- athetosis — Composite forms in various combinations.

Un Cas de Dégénérescence psychique héréditaire. Par Dr. Jakowlew. L'Encephale, 1887, No. 2.

The term "hereditary psychic degeneration" is proposed as the designation of a new nosologic group. Next to heredity, neurasthenia is the cause of most psycho-neuroses. The many phobias, which since Kowalewsky's work in 1885 are generally thought to be at bottom identical and named pathophobia, are among the most common indications of hereditary taint. The case, which is described at length, is of a prompter in a theatre aged thirty-six, and is of great interest and carefully studied, including compass and electrical measurements. The conclusions drawn by the author are that pathophobia, a sense of being possessed, and impulsive actions are products of the same conditions, and are attended by terror; that the patient is fully aware of the absurdity of his ideas (which circumstance distinguishes these cases from similar phenomena in cases of primary insanity), and that all these phenomena are connected with nervous weakness.

Des Intervalles Lucides, considérés dans leur rapports avec la capacité civile des aliénés. E. Régis. L'Encephale, No. 2, 1887.

The unsatisfactory nature of present French legislation on the relations between crime and insanity has been recently pointed out in an interesting series of articles in *Le Progrès Médical* for the current year, by the magistrate, A. Martin, in *L'Encephale* and elsewhere. One of the most vital points for the safety of society, as is well known, is the conception of lucid intervals, of which Dr. Régis distinguishes three kinds — remission or attenuation of the more marked symptoms, complete momentary suspension of symptoms, and intermission or a complete return to the normal state between two attacks. The distinction between remission and intermission is especially insisted on. Both as to the nature and duration of the intervals French law is inferior to that of ancient Rome. A permanent departmental commission should consist of a doctor and an officially subordinate administrator to minimize the present difficulties.

Diseases of the Nervous System. Vol. V of A System of Practical Medicine by American Authors. Edited by William Pepper, M. D., LL. D., assisted by Louis Starr, M. D. Philadelphia: Lea Bros, 1886. pp. 1317.

This large volume is made up of contributions from twenty-three eminent American practitioners, including Drs. Robert Edes, C. K. Mills, Weir Mitchell, J. J. Putnam, E. C. Seguin, E. C. Spitzka, Allen Starr, and H. C. Wood, and contains nearly sixty diagrams. The articles on general semiology, localization, mental diseases, hysteria, hystero-epilepsy, catalepsy, ecstasy, and disorders of speech are of especial value for students of psycho-physics. These topics, as well as many others treated in this volume, have now come to be represented by so voluminous a French or German literature, that even special students in the neurological field are bewildered in seeking a serviceable knowledge on these themes in continental publications or clinics. Such guidance this book is intended to afford. To specialists, as well as to the general practitioner, this volume is far the best in this field in English. That there should be repetitions, as well as great inequalities of merit in the different

parts, is not surprising on the plan adopted. It is greatly to be hoped that such a book may help to improve the quality and increase the amount of instruction given upon these topics in our medical schools. That but seven pages, and those not abreast of our present knowledge, are given to disorders of speech, and that nothing is said of hypnotism save very incidentally in the chapters of Dr. C. K. Mills on hystero-epilepsy and ecstasy, are defects, the one in the execution and the other in the plan of this volume, which we shall hope to see remedied in a second edition. Few chapters will be of greater value and interest to psychologists than that on Mental Diseases by Dr. C. F. Folsom, one of the most distinguished specialists in New England, and which is reprinted by itself.

Mouvement de l'Aliénation Mentale à Paris, from 1872 to 1885. A. PLANÈS. Annales Médico-psychologiques, January and March, 1887.

These statistics show a gradual increase of insanity, in proportion to the population, as measured by entrance to institutions. More men than women are afflicted, and most attacks are in June, and least in February and September. The most rapid decrease is from the middle of August to the middle of September, and the most rapid increase is from the middle of February to March and from the middle of April to May. From September to October considerable increase occurs, followed by a no less considerable fall to November. We cannot follow here the nine different forms of mental alienation for each sex which are clearly presented and suggestive.

Alternation of Neuroses. G. H. SAVAGE. Journal of Mental Science, January, 1887.

Not only do different forms of nervous disorders appear in different members of the same family, but epilepsy, insanity, depravity, idiocy, and somnambulism may be represented in the children of the same parents. Headache often alternates with insanity. Hysteria alternates with various neuroses; epilepsy, even asthma, disappears on an outbreak of insanity. Rheumatic fever and insanity are often associated alternately, and many functional troubles are relieved by bodily disease, on the principle designated in a late German essay as "kinetic equivalence."

A Manual of Diseases of the Nervous System. W. R. GOWERS. London, 1886.

The introductory chapter to these two volumes distinguishes four pathological classes of disease. 1, Coarse organic diseases, such as hemorrhage, softening tissue, etc.; 2, structural disease; 3, nutritional disease, chorea, and general paralysis, which latter the author judges so without structural pathology as to belong in neither the first nor second class. The chapters on general symptoms and on electrical excitability of nerves and muscles follow. Part first is devoted to diseases of nerves. In the section on neuritis and morbid growths, sciatica, to which an entire chapter is given, is called not a neuralgia but a neuritis. Of the five classes of multiple neuritis, the tabetic form only is provisional, and its relation to chronic alcoholism is undoubted.

Zur diagnostischen Bedeutung des Pupillenphänomene, speciell des reflectorischen Pupillenstarre bei Geisteskranken. Dr. THOMSEN. Charité Annalen, 1886, p. 339 et seq.

On a basis of observation of 1700 patients in the insane department of the Charité, the author concludes that most cases of reflex pupillary rigidity are paralytic, and that it is of much importance because it is sometimes found at a stage of the disease where other symptoms are wanting. Besides paralysis, it also occurs with aged dements, chronic alcoholists, in cases of lues, or lesions of the head without other symptoms of organic lesion of the brain, and sometimes, as with sane patients, with tabes, multiple sclerosis, paresis of the oculomotorius, cerebro-spinal meningitis, etc.

Pupillenreaction und ophthalmoscopische Befunde bei geisteskranken Frauen. Dr. SIEMERLING. Charité Annalen, 1886, p. 363 et seq.

These results are based on observation of 923 cases, and paralytic dementia furnishes by far the greatest number. One interesting case of hysteric origin was observed, but functional psychoses furnish but very few cases.

Psycho-Therapeutics. I. LESLIE TOLEY, M. D. (London). Am. Journal of Insanity, April, 1887.

This writer believes that "in the near future the general practitioner will pay closer and more systematic attention to that all-important branch of medicine—mental therapeutics." He will enter into the patient's tastes, sympathies, foibles, and the different powers and phases of his mind. The personal influence and manner of the physician, always so important, is chiefly so in nervous and mental cases. Pure and lofty sentiments are directly conducive to bodily health and vigor. Cheerfulness, art, literature, friendship, industry, proper employment, religion, music, change of scenery, good weather and climate—the influence of these is vast, and is likely to be recognized more and more, though by no means to the exclusion of the *materia medica.*

Observations with Sphygmograph on Asylum Patients. By T. D. GREENLEES. Journal of Mental Science, January, 1887.

So far from insanity having no pathology, as is often said, mania, melancholia, epileptic insanity, general paralysis, dementia, and imbecility show distinct and characteristic tracings, according to this observer, illustrations of which are printed.

L'auto-intoxication dans les Maladies. Par M. BOUCHARD. Paris, 1887.

The author shows by convincing experimental demonstration that the healthy body makes and eliminates poisons. The toxic power of normal urines is most clearly shown.

General Paralysis of the Insane. W. J. MICKLE. London, 1886.

This second edition of the above book is now without question the best repository of what is known of this disease—its history, literature, symptoms—that exists in English.

IV.—MISCELLANEOUS.

Pictographs of the North American Indians. A preliminary paper by GARRICK MALLERY. Fourth Report of the Bureau of Ethnology, pp. 1–256.

Taken in connection with the author's elaborate paper on sign language among the North American Indians, in the first volume of these Reports, and his other papers in progress but not yet published, Mr. Mallery's work is indispensable for all who are interested in expression of psychic processes by means more primitive than speech and writing. These studies are already so far advanced that types of execution may be expected to disclose data for priscan habitat and migration, as within each tribal or other system every Indian draws each figure in identical style. In this report nothing is attempted but to furnish a repertory for points on pictographic representation of ideas. The distribution of petroglyphs is very wide, from Eastern Canada to California, and extends far into South America. Pictographs on bone, wood, skins, gourds, and the human person, tattooing, the significance of colors, mnemonic quipu, etc., are discussed as illustrating the evolution of pictography. Then follows a very full explanation of the famous Lone Dog winter-count from 1801 to 1873, and of the still older count obtained by Dr. Corbusier which extends back to 1775, in which each year is marked by a pictograph of some distinctive event. Pictures of each of eighty-four totemic personal names of the Ogalala roster, and of two hundred and eighty-nine in the Red Cloud census, are given with English names appended. The symbolism of feathers, differently tufted, notched, painted; mystic personages, charms and fetishes, Shamanism, mortuary emblems, grave-post markings, pictographs illustrating daily life, tribal history, individual biography, modes of interpretation, frauds, and practical suggestions to collaborators, are topics which receive less attention. It is remarkable that no writer on this subject has extended his ken to take in and to attempt to co-ordinate the very different and independent work of the few chief writers, Darwin, Delsarte, Mantegazza, Clark, Mallery, and Warner.

Das Wachstum der Kinder. Prof. GAD. Humboldt, January, 1888.

After a short account of the special investigations on the topic of the growth of children since Quetelet, Dr. Gad proceeds to a convenient résumé of the very extensive investigation begun in 1882 by Malling-Hansen, director of a deaf-mute institute in Copenhagen, and now published in instalments. A system of weighing and measuring, daily and sometimes several times daily, was developed and applied, not without much expense, to 130 children in a way which inspires much confidence in the results, which are briefly as follows: Changes in the weight of children from nine to fifteen years are subject to three annual variations, viz. a maximal period, from August to the middle of December; a middle period, from the middle of December to April; a minimal period of three months, from the end of April to July. During the first period the increase of weight is three times as great as in the second, and all that is gained in the second is lost in the third period. There are three periods also of growth in height, viz. the minimal, from August to

the end of November; the middle, lasting to the end of March; and the maximal, from the last of March to the middle of August. The daily growth in height is twice as great in the middle as in the minimal period, and two and a half times as great in the maximal as in the minimal period. Thus the growth period extends from the end of March to December, and falls into two parts—first, the maximal period of height and then that of weight. Thus the minimal period of weight falls in the maximal period of height and *vice versa*. Increase of weight grows suddenly from a minimum to a maximum and then slowly declines, while increase of height comes on slowly and declines suddenly. In the maximal period of increasing height, growth in thickness is at its minimum, and conversely. He then infers that as much as possible of the periods of growth in both height and weight should fall for school children in the summer vaction. Besides these annual phases, these studies reveal growth periods of 25 and also of 75 days. Whether these are due to local meteorological conditions, as sun-rotation periods of 27 days, which Malling-Hansen calls growth energy, is not clear. The history of daily variations, especially in height, due in part to compression of cartilages and loss of elasticity of the arch of the foot caused by standing, and the converse effects of rest, is given with great detail for every hour of school life, and is full of interest. The author believes he has only obtained a very inadequate glimpse of a wide and rich field of research.

Le Surmenage Scolaire. Par CH. FÉRÉ. Le Progrès Médical, February 5, 1887.

The writer starts with the dictum of Spencer that the first condition of national prosperity is that the nation be formed of good animals. Sedentary life and intellectual work have always tended to become unnatural. Tissot, in his acute work on the health of men of letters, written in the last century, and Réveillé-Parise, in his book on the physiology of men devoted to mental work, Rousseau, and more recently Lagneau and Dujardin-Beaumetz, have directed public attention, with increasing explicitness, to the dangers of sedentary mental work, which are: I. Those due to unfit places. The site is often badly chosen. If the rooms are small there is more danger of contagious affections; insufficient air gradually impoverishes the blood, and anaemia, chlorosis, depression, bring receptivity to all morbific influences. II. Haste in eating, bad cooking, and food unscientifically chosen, cause defective nutrition of some parts or organs of the body. III. Clothing is often unpedagogic in form or thickness. Because of the proportion of surface to mass of body, children, it is known, lose relatively more heat than adults, and it is often forgotten that clothing is to an extent a caloric equivalent of heat, and that brain-workers need to dress warmer than muscle-workers. IV. Insufficient exercise brings constipation, then slow blood and nutrition so ill adapted to growth that even the teeth are starved into bad development and piles and incipient sexual weaknesses appear. V. Excessive labor is laid on the eyes and sometimes the fingers. VI. Bad attitudes. The race has hardly had time to adapt itself to sedentary intellectual life. Lying on the back is particularly favorable to brain circulation. According to elaborate statistics by Guillaume, the percentage of girls and boys who are more or less deformed by bad attitudes is

forty-one and eighteen respectively. Besides three distinct species of lateral curvature, all largely due to unhygienic attitudes in writing, other thoracic deformities are induced, the effect of all of which is to reduce the vigor of respiration, circulation, and impair nutrition and growth. VII. Vicious habits. Prolonged sitting favors pelvic congestion and local irritation, strongly inclining to masturbation, to which the mental anomalies of deterioration strongly predispose our degenerate youth. Since Tissot (L'onanisme: Œuvres, T. 1), many psychic and somatic troubles have been attributed in form to secret vice. The result is general exhaustion, causing troubles of nutrition, circulation, memory, and depression, irritability, fluctuations of mood, etc. VIII. Excessive mental labor. Moreau's "irritable diathesis" seems increasingly often caused among those striving to acquire culture in the lower classes, and the somewhat greater liability to this form of degeneration among the upper classes is due to heredity. In general, subjective sensations are more vivid in fatigue. Nervous exhaustion tends to depression, which precedes most vesanias. In fine, all these causes together are tending to that form of degeneracy which is incapable of productive effort.

The Children. How to Study them. By FRANCIS WARNER, M. D. London, 1887. pp. 80.

These lectures, given to the Froebel Society, are especially devoted to ways of observing nutrition, eyesight, facial expression, gesture, and posture. The functions of the arm, hand, and spine are especially to be scrutinized, and points to be observed during sleep are enumerated. Some of the cuts and conclusions of the author's work on physical expression, described in our last number, are reproduced.

Tachyhippodamia. By WILLIS J. POWELL. Reprinted in the Southern Live Stock Journal during July, August, and September, 1887.

This rare and often vainly-sought handbook, privately printed in 1838 and sold at a high price as the revelation of a valuable secret first discovered by the author in 1814 and perfected during twenty subsequent years, is here for the first time accessible to the general reader. The author was at first a teacher of Greek, Latin, and modern languages, who later acquired a fortune by this art of taming wild horses freshly caught from the plains of Texas and Mexico, in from two or three to six or eight, or in rare cases twelve or even sixteen hours, all without the least violence. The tamer approached the horse which had been driven, led, or dragged with the lasso into a small enclosure. The animal first turned his tail to the trainer, but in fifteen minutes or half an hour turned about. By motions so slow as to be almost imperceptible the hand was extended and the man approached, stopping instantly at the faintest sign of flinching or fear. At length the nose could be touched and tapped or patted by very slight but rapid movement. Inch by inch this "gentling" process proceeded to the neck, body, fore and hind legs, to the feet, tail, ears, etc., till the horse had been handled all over. All animals have much pleasure in dermal sensations, for the sake of which they will endure more and more sudden and violent aural and optical sensations, and these are the best means of removing fear, which

is the only feeling a confined animal has for man—these are his fundamental principles. An animal that rushes toward a man and would kill him if he fled or showed signs of fright, will always stop a few feet from a man who remains motionless, if there is no distracting object, so that the attention of the animal is fixed on no moving or sounding thing whatever save the trainer. As there are irregular verbs and nouns that do not fall under the paradigms, so he says there are exceptional horses, but none he thinks which variations of this method will not subdue. The secret, he argues, is the moral one of gradualness, gentleness and perseverance, and inspiring confidence, and all drugs, smells, violence, or magnetism are methods of quacks ignorant of the true psychic nature of the horse. Very interesting are the details of "gentling" a wild boar of great ferocity, freshly captured and uninjured, which could at first be only gradually touched with a stick through the bars of a pen, and of a freshly caught adult deer, both of which were so tamed in a single day as to eat out of doors and in public from his hand. Many certificates from military and civil officers of highest rank certified to the marvels of his art and the permanence of his results. The book is written in an accurate and naive way, with incidental allusions to learning and educational art, which gives it, though in slight degree, something of the charm of Isaac Walton, or White of Selbourne. This seems another illustration of the law that very great changes of impressions, whether of pressure, heat, or cold, can be accomplished without consciousness if they are sufficiently gradual—a law of wide range and great utility in education.

Le Leggi statistische del Suicidio secondo gli ultimi Documenti. MORSELLI. Milano.

This work is a continuation of the author's treatise on the same subject published in 1879, and is one of the very best illustrations of the exact methods of the anthropological school of psychology. The regularity of increase of the number of suicides, which constitutes one of the best arguments for the doctrine of determinism, is much greater than the increase of population. The larger the town the greater the annual increase. The yearly variations depend on cosmic, social, meteoric, and economic changes. The two zones of greatest frequency of suicide are the centre of the German population and Northern France. From these in all directions the frequency of suicide decreases like waves from a stone thrown in the water. This geographical scheme repeats itself on a smaller scale for other smaller centres, the great cities exhibiting, of course, the largest percentage, these latter and race being the chief factors. Like outbreaks of insanity and crime, suicides increase during months of increasing temperature. Spring, summer, winter, fall, is the series which represents decreasing numbers of suicides, June being the month of most and December of least frequence. Suicides increase with culture and civilization. In Italy about twice as many suicides occur in cities as in the country. The state of religious consciousness has a great influence on the tendency to suicide, which is strongest among Protestants; then follow Catholics, Jews, Mahomedans, fetish-worshippers, in decreasing series. Men are about four times as likely to commit suicide as women, but the percentage of women to men is greater in spring and summer, and of men to women in fall and winter. Each race and nation, how-

ever, has its own distinctive peculiarities in this regard. Liability to suicide increases regularly with age, and reaches its maximum by women earlier than by men, being great for both about the involution period. Unmarried life, especially the state of widows, widowers, and divorce, favors suicide, family life tending strongly against it, and widowers are more exposed to it than widows. Children are one of the greatest protections, especially for women. The well-to-do classes are more exposed than the poor. Among vocations, soldiers, and most the older subordinate officers, exhibit the highest percentage. The means of suicide vary regularly with the season of the year, race, climate, and culture. In Russia, Norway, and Prussia, hanging is decreasing and drowning increases. In Denmark, Belgium, Holland, and France, the reverse tendency is exhibited. Death by firearms is steadily increasing; by charcoal fumes decreases in France and increases in the west of Europe, especially in great cities. In northern lands hanging is the mode of death in three-fourths of all cases, while in the south drowning is more the fashion. Italians often precipitate themselves from precipices, and Anglo-Saxons often stab themselves. More painful and uncertain modes of death are rapidly declining. In Italy men choose firearms, women drowning. In Austria men prefer hanging. Unmarried women and servants prefer poisoning, and in each land each age has its preferred mode of death. Suicide is largely an index of social misery, and corrective influences are to be sought partly in the reform of popular concepts by philosophers and moralists, but also in a social reform which shall establish a better equilibrium between individual needs and the possibilities of social development.

L'Anomalie du Criminel. R. Garofalo. Rev. Philos., March, 1887.

There is a class of criminals who have psychic and often anatomical anomalies, not so much pathological as degenerative or regressive and even atypic in character. Some have traces of arrested moral development, although their faculty of ideation is normal. Others have instincts comparable to those of children or savages, are deprived of all altruistic sentiments, and act only under the empire of their own desires. These anomalies are absolutely congenital, and not produced by social or other environment, so that society has no duty to them whatever but to repress them. These are totally incapable of adaptation, and represent a source of continued danger to every member of society.

Le Délit Naturel. R. Garofalo. Rev. Scientifique, January, 1887.

What among the crimes of our day have always in all times and places been considered punishable? These acts are natural crime, judged from the sociological standpoint, and are opposed to the average moral sense of the entire community, from which laws and ethical systems and commercial ideas of right spring. There can be no exhaustive and definite catalogue of such acts made out, but it can only be concluded that all crimes are violations of one of the two great altruistic sentiments. The first is pity, sympathy, or humanity, and includes now defamation, assault, injury to the physical or moral health of children, etc.; and the second is the sentiment of honesty, including also a long list of special crimes, such as

theft, incendiarism, plagiarism, false testimony, etc. This does not include acts against the state, which vary with the particular conditions of nations. These sentiments are the substratum of all morality, and their absence, which is as much an abnormality as the privation of a limb or physical function, constitutes two distinct types of mental alienation.

NOTES.

I.—EDUCATIONAL.

An attempt has been made recently, in the State Normal School at Worcester, Mass., to enlarge the scope of the ordinary study of psychology, as well as to render that study more objective and more useful to students, by making the systematic observation of children a part of the regular work of the school. The object is twofold: first, to put the students (as prospective teachers) into closer and better relations to children; and secondly, to gather a store of well ascertained facts wherewith in time to increase and rectify our present unsatisfactory knowledge of child-nature. The mode of procedure, hitherto, is somewhat as follows: First, the aim and methods of the study are carefully explained to the students at the beginning of their second half-year in the school; they then improve such opportunities as they have or can find—at home, in the street, in the families of neighbors and friends—of noticing with care and minuteness the spontaneous and unconstrained activities, bodily and mental, of children of all ages—at play, at study, at work, in conversation and intercourse with each other and with adults, in all situations, relations, and moods. Then, at the earliest convenient moment, careful and concise record is made, on blanks provided for the purpose, of the facts observed, these being kept as free as possible from any reflections or inferences of the observers. The blanks are ordinary half-sheets of note-paper with printed heading, giving date, observer's name, initials of the child observed, its sex, nationality, age, and the length of time between making the observation and recording it. Different tints of paper are used as an aid to classification; for example, white for ordinary personal observations, cherry-tint for hearsay or second-hand facts, canary-tint for reminiscences of the recorder's own childhood, chocolate-tint for observations continued without break for a certain specified length of time, and so on.

The number of observations recorded varies, of course, from week to week with the opportunities that present themselves, but a rough average would be not far from two a week for each pupil. During the two years that the experiment has been in progress in its present shape, somewhat more than four thousand eight hundred records have been made, and these have been carefully classified by subjects and preserved for reference. Many of them, from lack of skill or judgment in the observer, have little value apart from the wholesome endeavor that made them, but a considerable proportion are of permanent interest and significance to any student of child-nature. Taken as a whole, they already form a body of facts not to be found elsewhere, and the practice by which their volume is continually increased also improves their quality. They relate chiefly to the knowledge and ignorance and errors found in children of different ages; to their

instincts, as manifested in play and in voluntary occupations; to the abilities of children in various directions, as shown in drawing, mechanical construction, hunting and training animals, letter-writing, rhyming, story-telling, etc.; to their feelings (hundreds of records covering a very wide field), memory, imagination, attention, moral sense, idiosyncrasies, etc., and are classified according to such rubrics.

In addition, considerable information has been collected bearing upon the treatment of children (injurious or otherwise) by adults—parents, teachers, nurses, grown-up brothers and sisters, etc., and also upon the kinds of literature, stories, pictures, songs, and the like, that children enjoy most and remember longest. As to the good effect, as training, of these observations upon those who make and record them there can be no question whatever. The students soon become noticeably more interested in children and their ways, and more skilful in dealing with them, while certain individuals acquire much tact and ingenuity in following out the more complicated and obscure processes of child-life. Moreover, they get some good practice in right methods of observation and investigation generally, learning in some measure the caution, discrimination, and veracity required in studying nature. The exercise, as a whole, stimulates and quickens. Students do not find it a dull task. They have to be restrained, or they would have given a disproportionate amount of their time to it. Finally, graduates who have had a year or two of this training before going out to teach, manifestly take more pleasure and are more successful in their work in consequence. They frequently fill long letters with accounts of the interesting traits they discover in their pupils, and it is easy to see that their attitude towards exceptional and troublesome children is often marked by unusual intelligence and sympathy.

How radical a modification of methods of teaching psychology is here involved is evident. The "natural" method, which has slowly reconstructed modes of teaching all other subjects during the last century, has at last reached the science of man. This is the field work of psychology. The following commencement essays of graduates last summer were based entirely on these studies: Falsehood in Children, Likes and Dislikes of Children, The Laughter of Children, What the School Child Thinks Of, How a Child Reasons, Plays of Children, Superstitions of Children, Study of a Child. A brief digest and tabulation of results of the above records, which are not without scientific value, will appear in the Journal later. Great credit is due to Principal Russell for the skill with which he has organized this significant new departure.

Several very recent investigations show that some children lack the power to distinguish shades of sound, both vowel and consonant, and hence are capable of quite a range of distortion of sounds. This does not seem due, at least in some cases, to defective hearing, and hence the term "sound blindness" more often used, or "timbre deafness," which Professor J. Le Conte suggests as more apt. From the many illustrations of the defect cited it would appear that defective carrying power of memory has much to do with it. This seems to be one cause of the great difference between children in learning to read, but the phenomena need fuller study than they have yet received. Not a few of the transformations and mutilations of words reported would make excellent stock in trade for low comedy as they stand.

Dr. W. Camerer, whose long experimental studies on the sense of taste, with his wife, are of such high significance, now reports (Zeitsch. f. Biolog., Heft 2, 1887) a careful study of two years' duration on the metabolisms of five children between the ages of seven and seventeen. During this period their food was observed and within wide limits regulated, their weight and growth recorded, excretion and even insensible perspiration registered at intervals. The results are too extended for report here, but the role of individual differences, especially of sex, the range of individual peculiarity in distribution of excretive function between bowels, kidneys, and skin, is surprisingly great.

An important hygienic educational address was given before the Berlin Medical Society, February 16, 1887 (Berlin. klin. Wochenschr., March 7, 1887), by Dr. Gehrmann, on "Insufficiency of the muscles of the trunk." The cause may be due to the muscles themselves, or be reflex, perhaps from intestines, womb, etc., and may be general or local. The position in sleep is of great importance for giving physiological posture. The results of defect are scoliosis, bilaterally asymmetrical growth, wandering liver, sinking kidneys, falling womb, too feeble action of one or both lungs and resulting fluxions, and irregularity and disease of the heart.

A most instructive case of hereditary juvenile degeneration is described by Mabille and Ramadier (Annales Méd.-psycholog., May, 1887). A boy whose neurotic parents felt schooling to be the chief end of life was isolated that he might learn more and quicker. Although industrious and ready of apprehension, he grew gloomy as adolescence approached. At eleven he was placed in a school where his reserved ways excited derision, which led to delusions of persecution. All acts in his environment had reference to him. Gradually mystic, erotic and demonic hallucinations developed, which were, however, mitigated by an operation for phimosis. Zoophobia was so intense that the sight of hens, cats, etc., caused pallor, tremor, etc. All these symptoms soon ended in rapid dementia.

Dr. A. Stewart's recent book on "Our Temperaments, their Study and their Teaching," is an excellent illustration of the revival of the theory of temperaments on a more scientific basis as the doctrines of phrenology decline. His book is designed as a practical guide, is very rich in literary illustrations, and tabulates the physical and mental characteristics of the four pure temperaments. The latter are considered as valid only to civilized, and chiefly for British races. The book is richly illustrated. The scientific plane of the book is about like that of Mantegazza's recent work on physiognomy and gesture. This, considering the obscure nature of the subject, is high praise.

A teacher of deaf-mutes has carefully counted the words used by deaf-mutes per day, and finds that, making allowance for abbreviations, scarcely more than a thousand are used, which is probably very far below those used by normal children.

No less than eight interesting cases have been lately reported in *Science* of sudden amnesia from shock or accident which remained

after consciousness was regained. Often all that preceded the accident by a few moments, hours, days, weeks, or even more, was permanently lost from memory. In one case at least, as perfectly normal health was slowly restored, memory of events came down to a point of time nearer and nearer the instant of the accident. In some cases there seems to have been some proportion between the length of the period of unconsciousness and the memory-blank before it. One writer thinks the memory is more likely to come down to the instant of injury if the latter deeply involves the senses, especially sight.

M. Ribot contributes to the October and November issues of his *Revue Philosophique* a very convenient summary of the scientific doctrine of attention. M. Ribot brings into prominence the distinction between spontaneous and voluntary attention. The former is guided by natural interest, by the most impressive sensations, and is well marked in children and in animals. The latter is a product of civilization and is an artificial process. Attention in any form is an unnatural state. It is a monoideism, while the nature of thought consists in a constant change. Attention is based upon emotion, and its genesis must be connected with role of pleasure and pain in the struggle for life. The method of inducing voluntary attention is by appealing to emotional motives, by substituting a mediate unattractive good for an immediate attractive one. M. Ribot also enrolls himself amongst those who regard motion as the essence of attention. Without motion thought is impossible, and all thought is initial action. J. J.

Mme. Clemence Royer contributes a very interesting article upon the notions of number in animals to the *Revue Scientifique* of November 19. Her main thesis is that animals have a good sense for forms and sizes of groups of objects, but that real counting is very limited, and the idea of "three," for example, as an abstract numerical notion is beyond their mental horizon. The trained dog does not appreciate the meaning of the numbers that he pretends to add, but regards them merely as an artificial means of gaining his master's approval; just as Sir John Lubbock's dog regards the labels that he brings when he wants something to eat or to go out. Animals are good geometers but poor arithmeticians. Geometrical notions are the more elementary of the two, and it is a product of civilization that has led us to substitute number for measure; to count instead of estimating "bunchwise," as do the uncivilized. Number is a perception to animals; it is an idea to us. J. J.

II.—EXPERIMENTAL.

E. Fischer and F. Penzoldt report a study of the sensitiveness of the sense of smell (Liebig's Annalen, Bd. 231, 1, s. 131) as follows: In an empty room of 230 cubic metres content, a weighed quantity of substance dissolved in alcohol was sprinkled by a simple atomizing apparatus. The air of the room was mixed with a great fan for ten minutes, and the subject whose sense was to be tested was called in. The most striking result was that mercaptan was perceived in volumetric proportion to air of one to fifty thousand million. Assuming 50 cubic cm. of air to be inhaled, so small a quantity as

$\frac{1}{46,000,000}$ milligram of mercaptan is perceived. According to Kirchhoff and Bunsen, it requires $\frac{1}{1,400,000}$ milligram of soda to be perceived in the spectroscope.

Dr. Fauvelle thinks that there is an inverse ratio between smell and sight. In some forms of life the olfactory organ precedes all other parts of the body and becomes very mobile. Extreme prominence of the nasó-labial organ not only limits the field of vision, but in some way is unfavorable to the highest development of the visual function. As the eyes acquire parallel axes and reach their highest perfection, the nose retires from its prominence in position and function. This may be true also of individuals and races.

Wendenski and Professor Henry P. Bowditch, of Boston, by different methods believed they had proved that, exceptionally to the general law that every tissue is fatigued by work, the nerve fibre in a nerve-muscle preparation was not exhausted by very long continued activity, and concluded that its function was approximately analogous to that of a metallic conductor. Professor Alex. Herzen (Arch. des Sciences phys. et natur., September, 1887) thinks he has proven conversely that when the muscle ceases to react to the stimulus of a prolonged tetanizing current its nerve is fatigued, while the peripheral end apparatus can continue to functionate.

Dr. J. M. L. Marique's thesis, entitled *Recherches experimentales sur le Mécanisme de Fonctionnement des Centres psycho-moteur du Cerveau*, though presented in 1885, deserves mention here for its admirable summary of researches on the excito-motor area and sensory centres of the cortex since 1870, and also for his novel method of experimentation, which, however, itself needs further study. He attempted to isolate the motor centres for limbs in the dog from the rest of the cortex by a vertical cut seven or eight millimetres deep around the sigmoid gyrus, severing thus, as he thinks, the arcuate association fibres without injuring the projective, or at least the pyramidal fibres. His conclusion is that section of the association fibres produces about the same result as severing the pyramidal fibres themselves, or that motor centres have no function in the absence of sensation.

Some of our readers will recall, as does the writer, an American who gave a few exhibitions of the remarkable power of not only playing different melodies of very different rhythm simultaneously with the two hands, but of writing with great rapidity, *e. g.*, a French madrigal with one hand while the other was writing a German sentence from Kant, a Psalm in Hebrew, etc. M. Paulhan, a French psychologist, has lately studied on himself the power of the mind to attend to two things at once. When he wrote the words of a poem while reciting another, the words or even letters of the two would occasionally get mixed. The confusion caused by repeating one poem aloud while mentally rehearsing another caused still more mixing. He timed the most rapid multiplication of a row of figures by two when done alone and the time required to repeat a poem by heart, and then found he could do both together in some-

what less time than the sum of the times of each separately. The simpler and more unlike the two processes the more nearly could both be done in the time of one, but very complex and similar acts cause much interference and loss, which is still greater if three things are attempted at once, as writing a poem with one hand and numbers with the other while repeating a song. The theory that in "double acts" the attention flits is not favored by these observations.

Interesting experimental investigation of the question whether after the brain had lost its function by sudden total anaemia its function could be restored by a supply of fresh blood, is reported by G. Hayem and G. Barrier (Arch. de Physiol. 5, 1887). Twenty-two dogs were decapitated, and from one second before to twelve minutes after the operation undefibrinated blood from a living horse was transferred into both carotids by a T-tube. If transfusion occurred after the head had become still, about two minutes after decapitation, respiratory movements, the corneal reflex, the secretion of saliva and tears were restored, and but twelve minutes after the knife fell the power of reviving any of these movements was gone. If transfusion took place four seconds after decapitation, the ordinary spastic movements ceased and apparently voluntary movements began again. Five or ten seconds after, while the voluntary movements of the head could be revived, the spastic motions could not be repressed. The latter, which generally cease in about ten seconds, can be restored if transfusion is made at once after their cessation.

A. König, in an article on Newton's law of color mixture and some recent experiments of E. Brodhun (Sitzungsber. der Berliner Akad. 1887, XVIII), urges that the principle that colors that look alike give mixtures that look alike involves the further statement that color comparisons remain valid if the intensity of all component lights is increased or decreased in the same proportion. This he shows is not quite correct for dichromatic systems like common cases of color blindness. By mixing light of wave-lengths 615 μ and 460 μ, a colorless mixture can be produced which remains colorless if their intensity is changed. A homogeneous light, however, which with a definite intensity of that mixture looks the same, becomes more yellow if the intensity is increased. To maintain the same color by such increase there must be a relative increase in the quantity of light of longer wave-length. The same thing is true of tri-chromatic systems. This is, however, harder to observe and is opposed to the results of Hering. It is best seen in mixtures of red, green and yellow reduced from middle intensity.

Tambroni and Algeni (Riv. Sperim. di Fren. XI) measured the duration of psychic reaction in the field of the space sense of the insane. The method of right and wrong cases was used in distinguishing whether one or two compass-points were applied. These observations, which require great patience and care, were made on four normal persons and four melancholics, dements, epileptics and maniacs each, making twenty-four patients in all. Two points required more time than one, and wrong judgments were longer yet. The average error, number of errors and time were also reduced by practice. These results with normal subjects were before known.

The effects of practice were observed only with maniacs and in part with epileptics. The aggregate results show that melancholics have the longest reaction times, and then come epileptics, dements and maniacs, and normal persons in descending series of times. That this scale or the numbers are typical it would at present be rash to affirm.

Tschis (Wjestnik. Psichiatrij, Bd. III) reports a study of the same problem with Flecheig's patients in Wundt's laboratory. Three cases of incipient dementia were psychometrically tested as to simple reaction time of choice, association and inference. With each subject an acceleration of the process of active apperception was demonstrated, whence Tschis concludes that morbid processes begin with a weakening of active perception. Every form of mental alienation, it is inferred, must begin with a reduction of the free creative function of will, for in this function the ego is determined by the entire conscious past.

Guicciardi and Cionini (Riv. Sperim. di Fren. XI) studied experimentally the effect of practice or memory, as they indifferently call it, on the duration of the following simple psychic processes, with tables for the successive days: simple reaction, the discrimination of touch on two points, the distinguishing of two spoken syllables with choice-reaction, the perception of three figures in predetermined order, reproduction of written letters, and word-association. The time beyond which no further reduction could be effected by practice was greater as the process was complicated. By very complex processes the longest time was generally *not* the first but perhaps the third reaction. After a pause of three weeks the reaction times were at first greatly increased, but very rapidly reached the previous minimum.

The results were not unknown before, the experimental process is not made very clear, and the theoretical introduction is very long and dull.

A prolonged and valuable study of the variability of the development of cerebral bloodvessels and their physiological and pathological significance, made by L. Löwenfeld, is reported in a late number of the *Arch. f. Psych.* The diameter of the basal vessels of the brain was measured in over 200 cases and compared with the weight of the normal brain. The relative variation was found so very great as to indicate that beside other factors, the nutrition of the brain is of great significance for its function. The sum of arterial capacity compared with 100 gr. of brain weight varied from 0.175 to 0.315 cm., age being a moderate factor in this variation. The left carotid was generally wider than the right. This variable has, in the discussion by the author which follows, great significance in explaining mental endowment, power of work, disposition to neuroses and psychoses, etc.

In a letter by Professor A. Pick to the editor of the *Neurolog. Centralblatt*, written Oct. 27, 1887, the statement of Prof. Steinbrügge that secondary sensations, or the fact that certain persons react with twofold sensation upon one simple sensation, were only known within the last few years (from which he is inclined to draw pathogenetic conclusions), is corrected by interesting citations from earlier

literature. In his jurisprudential psychology (1842), Friedreich cites the observation of a cultivated deaf-mute in whom music excited peculiar agitation in the feet and body which produced the most diverse moods. To these sensations, produced by different instruments, he gave color-names: trumpet, yellow; drum, red; organ, green, etc. Again, in the *Archiv ital. per le mal. nerv.*, 1865, says Pick, Berti describes an individual who, on looking at certain numerals, letters, etc., was impressed with imperative color concepts, and thinks it due to persistent association, and refers it to the field of Daltonism. This phenomenon seems to have been first named by Dr. Chevalier (Gaz. Méd. de Lyon, 1864) pseudocromastesia.

III.—ABNORMAL.

Dr. W. Stark (Zeitsch. f. Psychiatrie, 1887, Heft 2 and 3) recorded the weekly variations of weight in six periodic and six circular forms of psychosis. In ten of these cases each paroxysm, whether maniacal or depressive, is attended by a descent of the weight curve, and each interval by an ascent of the curve. Both changes were greatest near the beginning of the paroxysm or interval. Restlessness and reduction in the amount of food probably account for the decrease. A study of metabolic modifications during these psychic changes is strongly desiderated.

After describing briefly six cases gathered from literature of similar psychosis of twins (see also Galton's interesting chapter on the psychic peculiarities of twins), Dr. H. Euphrat (Zeitsch. f. Psycho., 1887, H. 2 and 3), adds an interesting account of two maiden women, alike in character, but physically and mentally different, both of whom, at the age of about 40, one two years later than the other, had very similar attacks of nervousness, hallucinations of vision, hearing, touch, somatic feeling, and delusional ideas. There was no hereditary predisposition save that the father died of delirium tremens. From this and the other six cases, Dr. Euphrat dissents from Ball's opinion that such cases are entirely due to anatomical likeness of brain structure, and thinks the similarity of the psychoses to be due to psychic contagion, induction, or infection.

In a paper presented before the psychological section of the British Medical Association, 1887, Dr. Hack Tuke would call many of the cases commonly designated as *folie-à-deux*, communicated insanity. This latter term should at least be applied to cases in which one member of a family becomes insane from over-work or distress for another insane member. Women are more liable to such contagion than men. Especially those delusional ideas that have some semblance of truth—notably delusions of persecution—are transferred. For this reason the mildly insane should not be cared for by their friends, especially if the latter are of nervous temperament. This class of cases need far more detailed study than they have yet received.

Dr. Battaglia, director of an insane asylum in Cairo, describes many experiments upon himself with different qualities of hashish (La Psichiatria, 1887). He produced a great variety of symptoms with great uniformity, but never the commonly reported euphoric

apathy. This feeling, as well as the vanishing of time and space, sexual excitement, hallucinations of vision and hearing, he ascribes to other drugs often mixed with hashish, which, if pure, is only soporific. Cannabism begins with a stupid staring expression, and passes to apathetic melancholy and dementia. The prodromal stages of paranoia predispose to this habit with the national apathetic tendencies of the Oriental character, as in America on the basis of a more excitable temperament they predispose to alcoholism. Total, as distinct from gradual, abstinence is on the whole the least straining method of cure.

Dr. Crothers, of Hartford, estimates that of the half million drunkards in this country, about ninety per cent die of diseases due to this habit, and about the same per cent inherit degenerative nervous systems. Drunkenness can never be successfully resisted so long as it is regarded as a vice or a crime. It is a disease, and the inebriate must be forced into quarantine and there be treated till he recovers. Society may demand that no acute drinker be allowed to become chronic and incapacitated for work, and to prevent this may treat the patient by isolation as if he had a contagious disease.

Dr. S. Tonnini presented his somewhat novel views upon secondary paranoia at the late congress of Italian physicians at Siena, where they were met with many objections. He now (Riv. Sperim. di Freniatr. 1887, XIII) defines it more fully as personally acquired by a previously sound person in distinction from primary paranoia, which he regards as the further development of an inherited neuropsychopathic degeneration. A degenerative state, if not proclivity of the brain, such as is often the inherited result of a psychosis in an ascendant, may thus in some cases be acquired in an individual experience. The inherited basis may indeed be bad, and even predisposing, but will not bring the individual to paranoia without a new impulse. Only in secondary cases does recovery or full-blown stupidity occur. The current view of secondary paranoia regards it as residual or sequent to more active delirium. Dr. Tonnini appends five cases which seem to conform to his definitions.

Dr. Rudolph Arndt describes a remarkable case of trophic disturbance due to violent psychic excitement (Deutsch. Med. Woch., 1887, No. 34). Albumen, hyaline cylinders, and epithelium from the urinary canal appeared in the urine, and the liver absorbed gall without any stoppage of the gall ducts. The author attempts to explain at length that psychic processes are only attendant if not incidental phenomena of metabolic and other physical processes. Therefore it is wrong to say the above symptoms were caused by fright, but they were rather due to the molecular-atomic processes set up by the shock, which, in reverberating through the system, affected the psychic organism first.

Edmond Grasset, in a very interesting doctoral thesis (Bordeaux, 1887) on alcoholic disturbances of cutaneous sensibility, based on very detailed tests on twelve subjects, distinguishes these symptoms as objective and subjective. The former are alphalgesia (painfulness of touch), thermo-analgesia, electro-analgesia, and especially hyperaesthesia, analgesia from pricks. These disturbances are

distributed irregularly in spots and do not correspond with distinct nerve areas, and change both spontaneously and from external cause, for, strange to say, dermal and organic reflexes do not seem to be modified by these areas. Subjective disturbances consist of darting pains, formication, etc., generally in the limbs. Besides these, disturbance of sensibility in deeper tissues and internal organs and organs of sense, sometimes somewhat resembling hysteric symptoms, is common. The cause may be peripheral neuritis, lesion of the internal capsule, and especially of the pons and crura.

Seppelli (Revist. Sperim. di Freniatr., 1887, XII) has studied the blood of 104 male and 96 female lunatics, with the apparatus of Hayem and Nachet, to determine how the number of red blood corpuscles compared with that in the blood of normal subjects. In the latter there are about five millions per cubic millimetre in men and four and a half in women. Seppelli found this number reduced over fifty-two per cent in men and over sixty-three per cent in women. In pellagra this reduction was greatest, in melancholia next, and in mania least. The proportion of white to red corpuscles (normally 1.650 to 1.1300) was not greatly affected, though the figures indicate that it was rather less than more. The quantity of haemoglobin (tested by the chromocytometer of Bizzozero) was also much reduced. Both these reductions seemed to this indefatigable investigator greatest near the beginning of the psychoses, and both abnormalities were greater in men than in women.

In the *Revue de Médecine* Féré gives an interesting case of a rich merchant of 37, who in 1886 began to have "absences," in which he would suddenly stop in the midst of any business and stand motionless and smiling, sometimes for fifteen minutes. He at length consulted a physician, to whom he told the following history: As a boy, he took all injuries very hard and would brood over them for hours in solitude. He used to lapse during these brooding fits into revery and castle-building, at first ephemeral and changing, but gradually permanent. He played many roles, according to his mood—soldier, statesman, scholar. After college, when business and domestic cares came, these reveries diminished till gradual insomnia brought back his musings, which now assumed definite form and took complete possession of him. For the last four years his reveries had slowly built a pavilion at Chaville with a pretty garden. By gradual additions the former became a mansion and the latter a park. Conservatories, stables, servants, and finally a beautiful woman came. Two lovely children crowned a joy that would have been complete but that his union to this imaginary woman (who was so real that he had grown entirely cold to his wife and almost forgot the existence of his children) was not legally his wife. These hallucinations were of visual origin and yielded to tonic treatment. Of similar nature, perhaps, were Mahomet's reveries during the years of cave-life, and Jeanne d'Arc's mystic daydreams among the hills of Lorraine, and many other visionaries who have become honest victims of their own fancies. This class of cases must not be identified with those described in Dr. Clark's book on visions, which begin in distinct optical delusions at first recognized as such.

Pseudo-hallucinations, as conceived by Kandinsky in his very

valuable book of that name, are described as perverted memory- and fancy-concepts as vivid as real hallucinations, but lacking the sense of objective reality without the patient, *e. g.* words heard inwardly with the spiritual ear without a realization of their subjective origin. This conception J. Hoppe opposes (Jahrb. f. Psychiatrie, VII, 1 und 2), as it involves laying too great stress on the mere subjective appearance of externality, instead of considering the state of the peripheral nerves of the sense involved. Kandinsky's carefully studied cases are criticised at length, and the phenomena referred to real hallucination due to either entoptic or subcortical material or to concepts. Inner hearing is also said to be often attended by unconscious and faint articulating movements.

The *Journal of Mental Science* lately contained an article on facial blemishes as a cause of melancholia, in which it was said that at about the age of forty, single women sometimes conclude they are not attractive, and magnify some real or fancied defect; and married women, fearing to lose their husband's affection, sometimes grow self-conscious or jealous. Hair on the face, wrinkles, fatness or leanness, or scars, may cause depression.

Multiple paramyoclonus, involving clonic and even tetanic contractions—not fibrillar but of entire muscles—of the muscles of limbs, neck, back, is hard to distinguish from convulsive tic, or from chorea major, save that it is often symmetrical and rarely affects the face. In a case lately reported, even the muscles of the uterus, heart, diaphragm, bowels, etc., were affected with the characteristic twitches. A neuropathic basis and shock or psychalgia are the etiological moments.

The *Neurological Review* calls attention to "the astonishing apathy that exists as a whole in regard to the importance of a knowledge of the nervous system in the daily work of every member of the medical profession." The writer reminds us that the nerves penetrate and to a greater or less extent control every organ and tissue of the body and every physiological function, and concludes that it is absurd to leave neuro-psychic matters to specialists in medicine, as is commonly done in practice.

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A STUDY OF DREAMS.

BY JULIUS NELSON.

Every psychological inquiry should as far as possible be based upon and connected with so much of physiological knowledge as we can command. It is not our desire to do this in the present article in any thorough manner, but for the purposes of introduction and orientation a few primary principles may be premised.

Look at the subject from whatever point of view we may, we cannot escape the fundamental conclusion that the human body, in its entirety, is a *cell-state or colony*. The individual acquires his character as a *unit* from the extreme differentiation and consequent division of labor obtaining among the cell units. There can therefore, in reality, be no *new* physiological or psychological function or faculty or characteristic in the soma which was not and is not in the cells. If the complex body seems to differ markedly in its powers from the simple cell, it is because the work

necessary to sustain the life of a cell has been distributed among many units, and thus many diverse combinations and interrelations of the cell functions become possible. Nutrition and growth (and reproduction), respiration and movement, irritability or response to stimuli, heredity and variability, and probably spontaneity or will, are the fundamental properties of protoplasm in its simplest state. All other powers of living things are secondarily derived by evolution (*i. e.* differentiation) of these primary properties, due to the *educating* forces of the environment acting through time. All these questions in biology and psychology, then, ultimately rest on cell physiology. We know very little about cell physiology, but we do know a few facts the knowledge of which will prevent us from making rash statements about the relations of brain cells to mental processes, such as are frequently made and which carry the air of final explanations. Such statements are, that images, stimuli, ideas, are impressed on the cell protoplasm just as if it were a photographic plate, and that consciousness simply "reads" these impressions. Memory is the strength with which protoplasm retains the impressions. When we learn a new thing it is stored up in a new cell, or a new connection between old cells is made. Finally it is asserted that nerve force (or at least stimuli), once flowing along a certain line or direction, maps out a "path," along which it becomes easier for it to flow next time, and so we form habits. The nerve fibres are supposed to represent the morphological result of such flows of force.

All this is crude fancy and finds no support in modern cytology. All the changes that take place in cells are undoubtedly chemical and physical. But the

actions of cell life are not explained even were we able to write the whole equation of the correlation and transformation of the forces present. We would still have to account for the *reason* of the change, for the organization of these forces, and, in fact, for that which makes the phenomena *vital* as distinguished from non-living chemical transformations. We know that complex chemical compounds are built up in cells with attendant absorption of oxygen. This requires energy, and that is furnished by the breaking down of the highly complex substances furnished by the food in the lymph and blood. Then when the cell works there is a liberation of energy due to the breaking down of these highly complex molecules, and waste products are thrown into the blood. The latest researches seem to show that, if not all the energy of a working cell, at least a great deal more than was formerly supposed, is furnished by the breaking down, not of the food directly, but of the living substances of the cell, which have themselves been built up out of the food. This is shown by the remarkable chemical and morphological changes which the *chromatin* of the nucleus undergoes when cells are active.

It is the chromatin, as we have shown elsewhere,[1] and as is now widely believed among cytologists, that is, as it were, the *brain* or *soul* of the cell. In it inheres the psychic or hereditary powers; and if it be removed from a cell, the rest of the protoplasm behaves automatically. The cell then moves mechanically, cannot reconstruct itself, and finally wears itself out and decomposes.[2] The difference between the chromatin

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[1] "The Significance of Sex." *American Naturalist*, January, February and March, 1887.

[2] See Gruber, "Beiträge zur Kenntniss der Physiologie und Biologie der Protozoen." *Bericht Naturforschenden Ges. Freiburg*, Vol. I, 1886.

and chemical substances that are devoid of chromatin is this. In the latter case any drug or stimulus produces an effect in accordance with fixed laws, but the chromatin has the power of interpreting stimuli, and its reactions are intelligently directed towards the preservation of its own life, and thus of the cells, and hence of the body. When a poison is absorbed by a cell, such poison forms chemical compounds with the protoplasm (therefore it is a poison), but the chromatin does not allow itself passively to be destroyed, but at once manufactures more chromatin as fast as it can, and thus supplies more than sufficient to satisfy the poison, and then the cell proceeds to excrete the saturated compounds.[1] In this way the chromatin can be *educated* to endure a great quantity of poison.[2]

The morphological structure of cells is such as the conditions of nature have shown necessary and advantageous for allowing the chromatin to live and grow, to differentiate, to receive stimuli, and to react upon the external world. Hence we have the chromatin in one or many spherical bodies in a nucleus, and the whole encompased by cell plasma that serves it for a house and for organs of relation. The structure of cells, therefore, is such as enables them best to do their work, such as absorbing food and moving by pseudopodia or cilia. There is not the slightest hint of structure with relation to anything else. They who think the complex structure of higher animals is in some way mirrored in their cells, or in the cytological structure

[1] See Stolnikow, "Vorgänge in den Leberzellen, insbesondere bei der Phosphorvergiftung." *Du Bois Archiv*, 1887, *Phys. Abth.* Supplement.

[2] Should later studies show that this reaction is not so simple a one as Stolnikow assumes in interpreting his sections, the general fact of the educability of protoplasm still remains.

of the eggs from which the cells are the descendants, do greatly err and have not conceived the problem of heredity from the vital and psychic standpoints. Cytologically at least, the ovum of a complex animal is as simple, even simpler than many of the single celled animals. In the same way must we think of the brain cells as in no great respect different from other cells. All cells are endowed with the fundamental properties of living matter, and when differentiation comes in, it is simply a distribution of these properties. A nerve cell is one differentiated especially to receive and react to stimuli in such relations or connections as to correlate organs. A muscle cell is one so constructed as to react by manifesting as great an amount of motion as possible. When a nerve cell acts there must be a breaking down of chromatin, just as when a liver cell acts. Who can prove that a splitting up of chromatin in the one case differs from that in the other, and who can imagine how such difference can account for consciousness or any psychic characteristic of ideas and sensations? Can we conceive that food which a little while ago was solvent in the lymph, and now has been built up into a complex molecule of chromatin, can remember, when a vibration reaches it and causes it to break up, that the chromatin which was its predecessor was broken up by a stimulus of like kind, (even supposing that the nerves are differentiated so as to transmit different sorts of vibrations or stimuli for the different sorts of external excitants, which is indeed an open question)? We see, then, that if anybody wishes to believe in *spirit* apart from matter, that this spirit can be *organized* and be an immaterial governor of material forces with which it can be in mysterious connection, and that the properties of spirit

and of matter are in no way similar, but totally dissimilar, such belief is in no way shaken by the very most recent advances of biological science.

We have seen that when a cell acts in any manner there is a degradation of chromatin. If this activity breaks down the chromatin faster than it can be built up, the cell must stop and rest. This resting, when it takes place in the higher psychic centres, presents the phenomenon of sleep. Only a few cells of the body sleep, and, as many parts of the brain are nowise tired out, they may still act during sleep. If these are the cells involved in psychic processes of some sort or other, we get dreams. In order that the tired brain cells may be allowed to rest undisturbed, the vital functions of the body are lowered to a minimal intensity. The easiest position is assumed, secluded from stimulation from the external world, because many of the cells are in good and increasingly good condition to react on stimuli, so that if these are not shut out, the restoration would be interfered with. Here, *habit* controls the action; for when the cells receive stimuli that have no significance for the welfare of the body, they do not *react*. The cells have to be educated to this attitude, for when unusual stimuli, as from a strange sleeping place, strike the senses, our sleep is more or less disturbed.

The blood does not flow so much to the brain during sleep, yet it is not altogether shut out, because food and oxygen are needed to restore the tired cells. This fact has much significance, for we know that when an organ acts it receives an extra amount of blood, and that in a general way the character of our mental activities is controlled by the amount of blood in the acting cerebral ganglia. It is therefore quite possible

that some ganglionic cells act in a feeble way all night, but, because of the feebleness of the action, we never recollect anything about it. But there may be disturbing causes, such as irregularity in the relations of controlling centres, or stimuli from diseased or uncomfortable organs, that tend to set certain ganglia into activity and call an increased flow of blood to the part, and thus vivid dreams will arise. As morning approaches, and the cells have gotten well rested and are quite irritable, they are ready to "explode" their chromatin at slight offence, and at last there is a general awakening, which is accompanied by a return of blood to the brain. There cannot help but be a "dawn" in consciousness just before getting awake and becoming aware of the external world, and thus people generally wake up out of a dream state. Of course the character of dreams will depend on several factors, such as the extent of the brain involved, the amount of irritability, and in a general way to the sort of stimulus, and of course on the interests, education and experiences of the individual in the immediate past.

There is undoubtedly one common psycho-biological law explaining the activities of the brain cells; how they act on a common stimulus producing a sensation; what is involved in perception, in an apperception; what in recollection; what in memory; what in reasoning; what in volition; what in desiring, and in emotions. How are the cells related; what cell activities are primary and what are secondary; which cells are exciting and which inhibitory? These are questions that must be answered before normal psychic action can be comprehended. Then we shall be in a fair way to readily comprehend how we get all degrees of disturbance of these normal relations leading down to the

deepest insanity. We shall then see why there is such a marked similarity among the different sorts of abnormal manifestations, such as the hallucinations of insanity, the delusions of hypnotism, the experiences of the dreamer, the fancies of revery, and still other facts in anthropology.

Although the ultimate solution of these problems depends on advances in the science of cell physiology, we need also to know all that other methods of study will yield. We must know gross anatomy before histology. I took up the study of dreams as a convenient portal to the general subject of hallucinations, and with the hope of adding to our knowlege of this most fascinating field of psychology. In the month of November, 1884, I began recording my dreams, and have accumulated the records of over one thousand dreams per year since that date. Two thirds of these are more or less elaborately detailed, so that we have here a great quantity of matter which will require much time to properly and thoroughly study. The present article is only a preliminary report due to a general survey of the data, and serving to introduce more detailed studies to follow later. It is to be hoped it may also stimulate others to study their own dreams at least; for only by comparison are we able to generalize and to discover what is idiosyncratic in these manifestations.

In many cases it helps a student to become thoroughly familiar with the work and theories of others in the special line he proposes to follow, to serve as a guide and to prevent the waste of misdirected efforts. In this study, however, it is best to read sparingly until considerable headway has been made in one's own method; the reason being that much of the literature in this

line is more of a poetical than of a scientific nature, and that a tendency to view one's own states with a special bias is readily and unavoidably given. There is a tendency to be interested in the *matter* of the dreams, in its æsthetic effects, much as we react towards ideas and events of real life in relation to our well-being. Of course this is the unscientific standpoint. The fact that a person dreams much or little is of more significance than *what* one dreams. A curve representing the variations from day to day in the amount of dreaming has scientific interest, while the hobgoblins that we saw are of interest to children.

The introspective method has two stages. At first we simply observe the phenomena presented by nature in their serial and concurrent relations, and from the light thus afforded we are enabled to experiment or to control certain conditions with advantage and intelligence. So far I have confined myself to the first of these methods.

There are a few pertinent biographical details that should accompany each student's memoir. I may be said to possess the dreamy diathesis in a strong degree, manifested from early childhood to the present time, a period of 30 years. My mental make-up is inherited mostly from the paternal side and is erethic in quality. The nutritive functions have been derived from the maternal side and present an irritable digestive system. My father rarely dreams, but my mother has many dreams in which she takes great interest. My memory is strong only in its visualizing power.

As a child I was subject to cramps, costiveness, and nightmares. The interrelation of these facts is evident. In regard to health, I have improved steadily with age.

Dreams that occurred before my fifth year of life are quite as vivid in my memory as the few waking

scenes of that period which I can recall. In the period lying between my eighth and twelfth years my dreams were peculiarly troubled; but at present my recollection of them is vague. On retiring I reviewed the events of the day over and over again, introducing variations and often new chapters with the slightest effort, yet had I undertaken to write a novel I should have failed. Often before my eyes there appeared mosaics of colors, expanding and contracting or rotating; and this especially if my eyes were shut. At times I could see malign faces appear on the walls with great reality and distinctness. If no nightmare caused me to awake during the night, the dream, however pleasant, always took a disagreeable and frightening turn on waking in the morning. I felt myself lifted up as if gravity had temporarily reversed its action, and then I was dropped from a great height back to earth, which I neared in increasing fear and loss of breath. But I always awoke just before striking the ground and when the fear seemed to be at a climax. Some mornings a pleasant dream would be substituted, and when the pleasures of anticipation of some rare treat were at a climax, just as the treat was about to be enjoyed, I awoke.

My mother taught me a remedy for bad dreams which I applied with immediate and universal success, viz., on composing myself for sleep, the object of a dreaded dream was by voluntary act brought before my mind, and while held there I said mentally, "Shall I dream of that?" (here visualizing the scene which past dreams had taught me to fear), and then the subject was dismissed with a confidence that I should not be troubled by that dream for that night. Should the feared scene again intrude into consciousness

before sleep came, it must once more be dismissed by the formula or my work were vain. Thus one by one I rehearsed the list of bugbears every night, making special effort not to treat pleasant subjects in like way, for then I knew they would not be dreamed about. By this means the mind passes from a state of fear, where the image haunts it, to one of confidence and control, where by some automatic action, similar to that by virtue of which we can wake up at a set time, the mind retains control throughout sleep.

I am subject to three distinct classes of dreams, which for convenience may be designated respectively (1) evening dreams, (2) night dreams, (3) morning dreams, as showing the time of the sleeping period when they most generally take place. Perhaps a fourth class could be added, viz., those excited by digestive derangements, such as nightmares ; but they are rather modifications of the others, due to extra exciting causes at work for a definite period during any portion of the night. The first two classes are rare dreams ; the third class makes up the main bulk of the dream record.

Class I. This takes place only when I can manage to get to bed when very tired and very sleepy, without getting thoroughly awake in the effort to doff my clothes. I am then in a semi-somnambulistic condition, while still conscious of my surroundings. While in this state I suddenly experience a nervous discharge which throws many of my muscles, sometimes including those of voice, into violent activity, as in a single twitch, so brief is the action. I have the sensation of passing out of a comatose state into the ordinary state, which is followed by tranquil sleep. Never has sleep proper followed such a state without this sudden dis-

charge and feeling of psychic change. Dreams often accompany this state whose tragic climax coincides with the discharge. Psychically the discharge is felt as the effort of the body to escape the impending danger, not through voluntary but through reflex action. Once, after severe exercise of skating, I retired with the sensations of the movements and scenes of the day reverberating through my nerves. While still conscious of my room, I lay reviewing the scenes of the day as they whirled by with unwonted vividness, until suddenly they became real, I was dreaming, a hole in the ice developed, into which I fell with a shriek and a struggle that was real and no dream, much to the amusement of my bedfellow. Had this been an ordinary dream I could have experienced the same series of psychic phenomena without the muscular movement. These dreams occurring immediately after retiring have no real sleep connected with them, while ordinary dreams accompany waking from sleep of longer or shorter duration. A strange sense of reality may sometimes be present when the scene of the dream is laid in my bedroom and I am conscious of being in bed; then on waking there is nothing to prove that it was a dream except the peculiar circumstance which the dream introduced. Thus one evening after composing myself for sleep I saw a white figure approach my couch. Full of dread, I threw up my arm to ward off the spectre, and awakening, it immediately vanished. On learning that no one had entered the room, the sudden and unreal way in which it vanished, and reflecting that had I been awake I should not have been frightened, and not being a believer in ghosts, I concluded it must be a dream. Thus a process of ratiocination was required to properly characterize the phenomenon.

Class II. This class results from excessive stimulation of psychic or sensory organs, by which, to use a material figure, the molecules of the nervous substance are so set in vibration that they continue to vibrate during a large part of sleep. Such reverberations are felt during the waking period as well. The boy who has spent a glorious Fourth of July retires with the booming of guns and the blaze of fireworks before his mind, and these images haunt his dreams in grotesque forms. The student, after hard work at his algebra, has similar experiences with x's, y's and z's. Sleep is disturbed; the brain is too full of blood to allow perfect sleep, and real rest comes not for hours. Perhaps the mind works, even in a logical manner, to solve vexed questions, though this must be seldom.

The dreams of Class III, as we shall see, are very different things; but before taking up this class, a few words about the dreams which we may designate as Class IV. Violent palpitations of the heart and intense peristaltic writhings of the intestines accompany such dreams in my case. Here I do not suppose the dream is to be considered secondary to the physical phenomena, but rather that by nervous or psychic sympathy the physical organ is reacted upon by dreams which it originally excited and determined the character of.

Class III, morning dreams. These occur when the brain has had a period of rest and repair; perhaps we may speak of it as a period of bloodlessness, and now, on waking, blood is rushing in, with a rapid rise of blood pressure in the brain. They differ also from other dreams in the faintness of their images, by virtue of which they are almost immediately erased from consciousness by external stimuli received on awaking. They

differ also from the foregoing classes in the fact that they are new or varied combinations of past mental experiences, worked up with great fertility of fancy and multiplicity of transformation. Events of the day before, preferably scenes of two days ago (as if those of yesterday were not faint enough) which have been forgotten, so trivial were they, are set in a background of scenes of my boyhood. The most trivial act of attention to an object one passes on the street, which would never again be thought of, is often the "hero" of a dream scene. No new sensations are introduced into these dreams; but just as soon as a new sensation is experienced in waking life, is it seized upon as material for these creations, which are after all only grotesque combinations, although exceedingly real in that they possess the detail and completeness of natural scenes. One may dream of riding on the cars who has never ridden on them, but his sensations will be simply those he imagined while awake, when thinking of the subject. Not until a person has ridden on the cars can he experience in dream the true sensation thereto belonging. This law holds in my case with every possible experience of life.

On the transformation of dream scenes.—In waking life one may see a person in the distance approaching who may be judged in all confidence to be Mr. A. On his nearer approach he is seen to be Mr. B. In this mental process there is no surprise, neither is there in dreams where a person judged to be A is shortly seen as B. The same is true of objects; and in this case of transformation, one or more of the objects in a dream scene may change without a corresponding change of the others, called for in nature. In this way places and things and persons never associated in our waking

experience are brought into juxtaposition, thus making it difficult to properly relate the parts of a dream to one another on waking.

A second method of transformation is by what I designate as *realized fancy*. In waking life, in viewing a scene or event I fancy certain modifications or expect certain things that do not occur, and properly should not occur except that the exuberance of fancy drags them in. In dreams I have similar fancies, but here I find them realized. If I picture to my imagination that I am at a certain distant place it does not take long before I am actually experiencing *passively* what a moment ago I was *actively* presenting to my mind. This is a fertile source of transformation in dreams. These transformations it is, that make it so difficult to remember dreams and to properly relate them ; for at times it seems as if an event might have two antecedents in a dream, as if one had a double consciousness for a short time, and had been enacting a rôle on two different fields at once, which in some unaccountable way became one field and one person. Perhaps it is only a difficulty of the rational mind in trying to remember what took place in a mind in which reason was dormant.

We are now prepared to discuss *methods* of record and of study of the record in connection with the results obtained by their application. One must accustom himself to holding the attention fixed upon the scenes of the dream world after waking in the morning and not allow the attention to be diverted for an instant to the scenes of the external world, or the superior strength of its impressions will instantly blot out the faint images of the dream. Then, by carefully reviewing the events of the dream it may be

more indelibly fixed on the memory. It is well, however, to have pencil and paper at hand and jot down the dream, at least skeletonwise, to aid in reconstructing it when the record is more carefully made. A single word in this way is sufficient to recall the dream by. Objects we meet in our daily walks, by a similar process, set us to feeling that some experience has passed in our life in connection with them somehow, and when the experience is unravelled it is found to be the fragment of a dream, which dream was either suggested by the object itself when it was scarcely noticed a day or two before, or if it had made a strong impression, that impression was made long ago, or else the object is similar in some way to the dream object so as to suggest it. One has to have his note-book with him all the time, for he knows not when an object may help him recall a dream. I find that the completeness with which a dream can be recalled, roughly speaking, depends inversely on the time which has elapsed between its occurrence and its first recollection. But a similar law governs all subsequent recollections. Thus if a dream be carefully rehearsed to fix it on the mind before rising, and a word or skeleton "suggestive" be made, should a portion of the day's activities intervene before the dream is recorded, the "suggestive" will aid in restoring much less of the details than if the scenes are fresher. The dream itself has all the completeness of nature, and if immediately observed by the active attention can be studied as a landscape is, except in the case of dreams one is allowed only a momentary peep at the scenery and then has to restore as much as he can recall. The dream records I have made are therefore very meagre compared with

the real dreams. The relation is exactly similar to that existing between a landscape itself and the description of a landscape by a passing tourist. But I find the impression of a natural scene, however short, is stronger than that made by these exceedingly faint images.

When I first began recording, the mind seemed so full of the subject that I would wake up during the night just to dream and to record dreams. So I had to put a sliding frame with a slit in it over my tablet to guide the pencil while writing, or else the lines would be superimposed in an undecipherable manner.[1] But this extreme zeal caused nervous prostration. It is a really exhausting process to keep the attention held on faint impressions in the presence of strong ones, and the effort to recall the faint details is also exhausting, so that I was compelled to adopt a more careless attitude of mind towards the record; but I think the laws we shall subsequently reveal have not been thereby affected.

When the attention is turned to a dream scene passing in the mind, on awakening it can recall certain antecedent events that join onto the ones present, and so on back into the night; though of course we must not let the time relations presented by the dream be any guide here, for one can dream of a year in a minute, or take part in events lasting hours in a moment. The dream stretches back and grows fainter and fainter until no more can be recalled. This seems to harmonize with the view that our morning dreams take place only during the passage from sleep to wake-

[1] Such writing, made by the sense of touch and motion, is crowded laterally as one feels that he passes over more space than in reality.

fulness, or while the blood pressure in the brain rises from a lower to a higher level.

Now, when the mind travels backward over a dream in the way last indicated, beginning with the dream scene present when just awakening, it goes backwards by jumps; that is, the dream has a moniliform or segmented character. It is a chain composed of links of more vivid scenes connected by scenes less vivid. The links only are recalled in the inverse order; the events inside each link are seen in their true progressive relations. When from any reason the scenes are less vivid, as from having allowed the outside world to intrude upon the attention, the fainter parts drop out, and these parts usually correspond to those details by which some principal object, person, or event of one link becomes by transformation the nodal or focal point of the succeeding link. In such a case the two links seem distinct and are recalled as distinct dreams, though the mind has a vague sense that they are only fragments of longer dreams without at the same time connecting them. Several links may be bound together into larger links. This appears to be due to the mental relations of the events themselves; but it has occurred to me that there might be a physiological explanation of this moniliform character in that the blood pressure varies with the pulse and respiratory movements, and as the waking period occupies a few of the larger and many more of the shorter waves, we here have something quite corresponding.[1] If the dreams are vivid, or if memory is good, then we have one long dream composed of many transformations. If the dream is less vivid we get a few fairly

[1] See Mosso, "Über den Kreislauf des Blutes im menschlichen Gehirn," Leipzig, 1881.

long dreams, although some of these may be short and consist of but one node. Then if the dream has been very faint we get only a few scattered nodes of events, persons or places about which we dreamed, but we cannot recall details. We can also secure all these conditions by recording successive days in bed, or after rising, or after breakfast, or after dinner, or after supper, and if we wait until bedtime we can be glad if we are able to recall a single particle of dream. But suppose we make a practice of recording the dream, say just on awakening, then we shall find that some mornings we have the greatest degree of vividness and unity, and on others the least degree, and with all intermediate stages represented by different mornings. *It therefore follows that the number of dreams a person can recall has no direct significance, but only the total amount dreamed.* Guided by this law I proceeded to count the total number of words in the dream record of each day and to plot the curve for the whole time, and the results obtained we now proceed to discuss.

Some dreams are so vague that nothing of detail can be made out, but only that I dreamed about such or such thing, or that I recall a single object out of a dream scene. This object I have designated the node or focal point of greatest vividness. This node is the last to fade out, and if the dream scene was vivid enough it is by means of this node that the memory restores the accessory details. I divided the dreams into two classes, viz. those consisting of a single bare nucleus and those more complexly organized. In a table at the close of this paper I have grouped the daily records according to length from 1 to 900, which was the longest record for one day. Opposite each group I have placed the number of days that presented

records of that length, and in a third and fourth columns the corresponding number of dreams, complex and simple; in two additional columns the average daily number of dreams; and finally, the average length of the dreams. A little inspection shows us that the simple dreams tend to remain stationary, or to decrease in number as the record lengthens. The complex dreams, while increasing in number, do so at a rate of increment 100 times smaller, while the average length of dreams increases five times as rapidly as their number. As the unit of measurement is diverse in these cases, this relation simply means that the average length of all dreams is 100 words. These facts are in perfect accordance with the theory. It is total amount and not the number of dreams dreamed that measures the physiological action.

We have already seen how easily the length of the record for any day may be affected if the attention is called off, if one oversleeps so as to be hurried, and various other things occur to curtail the record. The two chief causes of disturbance are pressure of work and unusual experiences or occupation, excitement, etc., like a journey, for instance. I was able to pick out of my record thirty consecutive months which were fairly uniform in my experience, the great disturbing sources not having acted many days at a time during this period.[1] The first two weeks of my record show a steady rise in the curve, which is in accordance with the law that attending to one's dreams increases their number, *i. e.* increases the number we become aware of having. But this law ceased to operate after the climax was reached. The curve was seen to be very irregular,

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[1] I later discuss a disturbing action which was present regularly during each May and June.

with a mixture of short and long records without apparent law; still one could discern a crowding together of the long records at certain points. A parallel curve of the moon's phases showed that the two curves were independent. I then chose the physiological or sexual month of 28 days and found there the period I sought. I thought that 30 months when summated would be sufficient to equate the petty disturbing influences, and thus I could get a curve approximately showing the actual state of affairs.

The table at the close of this paper shows the numbers from which the curve has been constructed. The nature of this curve and the fact that it was plotted for a menstrual period requires that we compare it with a curve representing the sexual condition. In the human female we have presented the monthly phenomenon of the katamenia lasting nearly a week. This phenomenon has relation to the functions of reproduction. Although the phenomenon is still not thoroughly understood, we have data[1] which show that during this period one or more Graafian follicles burst and set free ripe ova which are passed down the Fallopian tubes, and if fertilized, remain to be developed in the uterus. The cause of the bursting of the follicle is due to a congested condition of the ovaries, or a heightened blood pressure in them and accessory structures which may account for the uterine hemorrhage, but coitus may probably accomplish the same effect and thus prevent an impending menstrual flow. At any rate, after the flow has ceased an ovum is present in the tubes or uterus most favorably placed as regards fertilizability, and it is well known that the female is

[1] See Geo. Arnold, "Zeitliche Verhältniss der Ovulation zur menstruellen Blutung." Würzburg, Dissertat. 1887.

most erotic and irritable at this time. The physical cycle is accompanied by marked psychical characteristics that gradually increase up to the period, and after a temporary decadence during the flow, present a sharp climax a week later. We shall term the first climax the *minor climax* and the second the *major climax*.

It is readily seen why the erotic state should be at its climax when the ovum is ready for fertilization. We have no direct means of measuring this condition as a curve, but we can do so indirectly. The first curve of the plate marked *A* is taken from Hermann's Handbuch der Physiologie, Bd. VI, part II, p. 74, and represents the frequency of conception with time-relation to the menstrual period. The two climaxes above noted are well shown, though the curve was plotted only with reference to a preceding menstrual period and not with reference to a subsequent one.[1] As the periods of women differ in length, the minor climax does not come out in its true sharpness and height. Undoubtedly there are other ways probably superior to this one of measuring this physiological period indirectly, but I am not aware that any available data have been gathered with reference to this point.

It would only seem natural that the male should also show a sexual period corresponding to that in the female, and that in well matched couples the climaxes would coincide. Concerning this point we read in Foster's Physiology (page 691, fourth English edition, 1883): "Within the year an approximately monthly period is manifested in the female by menstruation,

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[1] The dotted curve was plotted with reference to the close of the period, the other with reference to its beginning.

though there is no exact evidence of even a latent similar cycle in the male." On the other hand, in Dr. Hammond's "Treatise on Insanity," published the same year (page 114), we read, "Gall contended that there was a periodical manifestation in men analogous to that existing in females, ... and Lévy holds a similar opinion. The latter states that 'young and robust persons do not notice this tendency unless their attention is specially directed to it, but men feebly constituted, or endowed with a great degree of irritability, or who have reached the period of their decline, perceive the alteration which their health monthly undergoes. . . . . The feeling of discomfort is general and inexpressible, and the mind participates in it, for it is more difficult to maintain a train of ideas; a tendency to melancholy, or perhaps an unusual degree of irascibility, is joined to the indolence of the intellectual faculties. These modifications persist some days, and disappear of themselves.'

"I have certainly noticed in some of my friends this tendency to some monthly periodical abnormal manifestation . . . . I think this is much more common than is ordinarily supposed, and that careful examination or inquiry will generally, if not invariably, establish the existence of a periodicity of the character referred to."

In my experience, young and robust persons are subject to recurrent periods of wakefulness at night, which, when they coincide with the full moon, are attributed to the action of its light. Undoubtedly the light of the moon has an independent action of this sort; but if Mantegazza's theory is corrrect, that the sexual period became established with relation to the lunar period because moonlight nights were favorable

to courting, there is a strong association existing between the moon's light and the excitation of the psychic-sexual functions. However, the period long ago became so firmly established as to run independently of the phases of the moon, and even to vary from its length so as to have a precessive relation to the moon's phases. The influence of that old institution, the Sabbath, must have had a powerful effect in fixing the period at twenty-eight days; but this period is easily influenced by exciting or nerve depressing causes, the former shortening the interval, and the latter delaying the period, or even preventing it to a great extent.

In the male as in the female, the maturation of the reproductive elements is a continuous process, though we may hardly say that it is not influenced by this mensal periodicity. It certainly is influenced by many incidental forces, such as food, temperature, exercise, occupation, sexual excitement, etc. But here, as in physics, we ought, I think, to consider each force still acting and producing its proper effects though the resultant may fail to reveal the direct action of any one element at a particular time. The mensal period is a steady force, the others are accidental and variable in time; hence if we take a sufficiently long period and summate by months, the disturbing forces will largely equate their effects, whereas the mensal force will thus reveal its true action. The presence of the reproductive elements exerts a constant stimulus upon the brain cells, which causes them to generate characteristic dreams that in turn react to produce expulsion of the gametal cells.[1] This *gonekbole*[2] will be more frequent at periods when the psychic cells are

[1] See Martin, *The Human Body*, Appendix, p. 13.

[2] *σπερμοβολία* is the more correct term, but scarcely as convenient.

most irritable, and therefore furnishes data for plotting the sexual curve in the case of the male, and the result is shown in curve *B* of the plate. As in the previous curve, it is only an *indirect* measure of the physiological rhythm we are considering. Here also we get two prominent cusps in the curve, in the form of a minor and a major climax, one week apart, and thus exactly corresponding to the climaxes in the case of the curve *A* of the female. The figures on which this curve is based are given in the table.

A similar treatment of the dream values gives us curve *C*. Here the two climaxes appear again in their corresponding positions, but approximately equal in value. In the sexual curve the climaxes fall on Tuesdays, while in the dream curve they occur on Wednesdays, a day later. The curve keeps near its average level between the climactic points. It sinks below the average during the two weeks succeeding the menstrual week, and as we approach this period it rises again, becoming in the case of the dream curve a marked climax during the week preceding the period. There is a curious descent in the curves (most marked in the case of the curve *C*) on Monday mornings. This must be due either to the influence of Sunday, or else to the fact that the mind is somewhat anxious as it is about to resume the cares of a new week, which anxiety acts probably as a constant factor in disturbing the completeness of the dream recollection.

It is an open question whether a rise in the dream curve represents increased power of recollection, or increased vividness of dreaming, or increased irritability, or all of these together. We are inclined to believe that the mensal period is at bottom a rhythm of the vital or psychic nature and influences probably all

the activities of mind and body. Hence these activities, when properly observed and measured, become indices of the more fundamental rhythm which they thus indirectly measure, or at least reveal. In the case of the knee jerk reported in the first number of this Journal it was shown how exceedingly sensitive it was in its responses, indicating diverse external and internal conditions and changes. It appears probable that had the experiments been conducted over a sufficiently long interval they would have revealed a monthly rhythm. We also suspect that a great many psychophysic reactions are modified by this rhythm, and the extent to which they are thus subject ought to be determined before we can rightly interpret the results.

Another question which occurs here is this, what sort of a rhythm is the mensal period? There is no fact in nature more prominent than the occurrence of periodicity, and these periods are of almost infinitely varied lengths and variously and complexly compounded. Many periods are secondary and resultant, being dependent on others. In physiology nearly all the periods are in relation to cosmic rhythms, to which they are related not as physical resultants but as vital (or intelligent) responses. The occurrence of the one is a "sign" to the protoplasm to act out the other. Yet we have hinted above that the living being may anticipate the stimulus and react at the proper time, in the absence of the stimulus, and thus have an independent rhythm of its own. How this is done is one of the mysteries of biology yet to be solved. We consider this sexual rhythm as belonging to this category.

When we analyze the figures that enter into the value of the dream curve, we find that several components are active in producing the result. Thus the

occurrence of the ekboles themselves has a modifying influence on the dream value, tending to raise it. But even when all the dream values coinciding with days of ekbole are thrown out and the remaining days summated, the character of the curve is not seriously altered, though of course reduced in value. Let us call the curve thus stripped of its over-tones, so to speak, the *fundamental;* then I found that an ekbole occurring at or near a minimal point had the power to raise the fundamental by a half of its value, but on a maximal point the increment became one fifth of the fundamental value; the average power of increment for all (mixed) cases being one fourth of the fundamental. The ratio of minimal cases to maximal cases, an equal number of each, is 1 : 1.11 in the compound curve, 1 : 1.41 in the fundamental, and 1 : 1.33 in the mixed or normal curve.[1] Although the relative value of the increment is less in the case of the maximal point than in that of the minimal point, the absolute value is about twice as great in the latter as in the former case. This is in accordance with what we should expect. The ekbole causes increased flow of blood to the brain, on the presence of which the dream value so largely depends. This increased flow is relatively more marked when the brain has less blood in it (at minimal points) than when it has a larger quantity of blood (as at maximal points).

When, therefore, an ekbole occurs, the dream value is raised by the ratio 1.25 as an average, and then it falls again to its normal value; but when only

[1] The curves in the plate, *i. e.* those obtained directly by plotting the results of observation, are "normal," or, in the present case, "mixed" where the summation of two sets of values is concerned; one set being unaccompanied and thus unaffected by ekboles, and therefore belonging to the fundamental system, and the other set affected by the presence of the ekboles, and therefore "compound."

one day intervenes before the next ekbole the fall is not so great, the ratio being here 1.10 : 1. The effect of an ekbole to raise the dream value is not so great when it is closely preceded by another ekbole, but in 33 cases presented by our data the ratio of the first to the second was 4903 : 6168 or 1 : 1.25. We shall proceed to show that this ratio, which seems to contradict the last statement, is due to the influence of the fundamental curve. When we analyze the cases more carefully we find that some of them contradict the result we obtained by addition. When these contradictory results are compared with the state of the fundamental curve, we find that in most cases the result has been due to the effect of this curve overcoming the effect properly due to the ekbole. Thus when we know that an ekbole raises the dream value, but we meet a case where a day free from ekbole just preceding or succeeding has a higher dream value, we find an explanation for such a phenomenon when we see that such day is nearer a maximal point than the ekbole day. This law is perfectly plain when we assume that each of the forces acts to contribute its effect independently of the others. The effect of an ascending curve raising all values and a descending one depressing them is readily seen in the tables. Now, therefore, analyzing the above ratio in this way, we have:

	Number of Cases.	Ratio.	Number of Cases.	Ratio.
First day greater than second.	6	1.40 : 1	12	1.92 : 1
Second day greater than first.	9	1 : 3.68	6	1 : 2.69
	Influence of curve is same way.		Influence of curve is contrary.	

The fact that so many cases show that the first day is the greater even when the influence of the curve is unfavorable leads us to announce the law as above, even though the ratio obtained by summation of all the cases is the reverse. But this ratio is a compound one, and we wish to eliminate the effect of the fundamental. Were we dealing with physical facts accurately determined, we should expect that the ratio 1.40 : 1 in the six cases where the first day is greater than the second (in accordance with the inferred law), when the fundamental assists this result, should be greater than that of 1.92 : 1 where the curve is contrary. This illustrates the peculiarity of physiological data. The element of disturbing influences is so great that exceptional cases are always occurring, especially when the number of cases is small as in this instance. For this reason, though we treat the numbers while performing computations as if they were accurate, we have no right to regard the results as accurate. They may be very inaccurate and even contrary to the truth. But by taking a large number of cases we are justified in regarding the results as *indicators*. Thus no significance can be attached to the particular form of our curves, but they simply indicate that there is a heaping up, as it were, of some influence at the occurrence of the menstrual interval. We should require an infinite number of cases to eliminate disturbances and make our figures have mathematical significance. This point deserves to be kept in mind while dealing with such a problem as this.

We saw above that the length of dreams increases nearly as fast as the increment in the daily record, that is, an average of 100 words must be added to the record to give an additional dream. We have also

seen that the occurrence of an ekbole raised the dream value by the ratio 1.25 as compared with the day preceding or succeeding. When the number of dreams are compared for this case, it is found that there is no difference in the number of simple dreams, but that the complex dreams are increased in number more rapidly than the record. Thus 164 cases of ekbole against their succeeding days gave an average ratio of 2.9 : 1.9. This signifies that the continuity of dreaming is by this influence broken. The fact, I think, is readily accounted for by the process of awakening that often accompanies the ekbole.

We have now to consider the annual variations. Each year contains 13 physiological months. Out of the 30 months from which I plotted the monthly curve, I chose 26 consecutive months for plotting the annual curve. I found that (as our table shows) there was a minimal point at March–April and a maximal point at November–December. The two years are closely similar in these respects. The dream value being the summation of 28 days is to be relied on for a curve, but the ekboles are too few, of course, to give a corresponding gonekbolic curve. We can readily perceive this on inspecting the number and seeing how one year contradicts the other. So we shall leave the ekboles out of consideration and seek to get at the sexual variations in a different direction. The two years combined give us curve *D* of the plate. It is quite plain that at the region of the winter solstice, rather more before than after it, the curve is maximal. It is also plain that the curve is minimal at the time of the equinoxes, the fall being in our curve greatest at the spring equinox. There is a slight rise at the approach of the summer solstice; but when we compare the curves *E* and *F* in these respects our dream

curve seems sadly deficient. It is quite probable that this deficiency is due to the fact that about this time the change of life from the routine of study to the recreations of vacation acts detrimentally to the dream record. Indeed I know by experience that I was not so faithful in my records at this period as at other times.

In the animal and plant world the periods marked by the approach of the two solstices are marked by reproductive activities. This has relation to climate, of course, and not to the astronomical facts directly. The winter is provided against by well protected winter eggs and seeds; and in the case of mammals the gestation period has place during the winter that the young may be born at such a time as to have the advantages of summer. The direct effect of food and temperature in early summer is of course to nourish the reproductive systems, and where the young can be quickly matured reproductive activities are quickly instituted. Psychically the human male feels the approach of summer as a "spring fever," which is probably of sexual significance. To some extent Düsing[1] has worked at this problem and shown that the frequency of conceptions in the human being varies during the year, having maximal points at or near the solstices, but he finds the major climax at the summer solstice, and attributes the other rise in the curve, at the winter solstice, to the influence of the Yule festivities. Our curve *E* is taken from page 98 of his work, and represents the conceptions in Sweden, summated for 1851 to 1855.[2] Düsing also shows us

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[1] Die Regulierung des Geschlechts Verhältnisse.

[2] The figures for Sweden do not show the marked climax in June which is true of other countries. The curve is, however, pertinent here, for comparison, as I am of Scandinavian blood.

the interesting fact that as the births increase the increment acts unequally on the production of the two sexes, the girl births suffering more variation than the boy births. Our curve F has been plotted from data furnished on pages 298 to 300 of his work. The ratio of boys to girls is given, and this ratio falls as conceptions increase in frequency. We have plotted the variation from the average ratio, and have moreover transposed the plus into negative so as to make the curve parallel with our other curves. It therefore shows variability in the girl births directly and in the boy births indirectly. There is of course no reason why of two variables one shall be rather chosen as a constant than the other. The dotted line represents the average ratio; ordinates above the line represent a fall in boys as compared with the girl births.

Now what seems plain on comparing all these curves is this, that in the monthly period the variation in the dream curve is parallel to that of the sexual curve; that in the annual curves the dream curve is parallel to the curves showing increased sexual activity, and these again to that showing the regulation of the sexual ratio; it follows, then, that we should expect that were a curve constructed showing the variations of the sexual ratio as related to the menstrual period, we would discover an important relation existing between the mensal rhythm and the production of sex. It seems to me the matter is well worth investigating. It has been supposed that the relative ages of the reproductive products and the relative state of "heat" in the sexes influence the sexual ratio, but this seems likely to be complicated by the influence of the sexual rhythm.

The months immediately succeeding the time for which we have summated our data were disturbed by

a trip to the tropics. In this case the approach of the summer solstice was aided by the action on the system of an unusual climate, the result being to vastly increase the record in the region corresponding to Düsing's major climax. This fact taken in connection with what we stated above tends to show that our annual dream curve is too low for the month of May.

TABLE SHOWING THE RATIO OF INCREMENT IN THE DAILY NUMBER OF DREAMS AND THEIR AVERAGE LENGTH, COMPARED WITH THE INCREASE IN THE DAILY RECORD.

Length of Daily Record in No. of Words.	No. of Days.	Total No. of Dreams. Complex.	Total No. of Dreams. Simple.	Average Daily No. of Dreams. Complex.	Average Daily No. of Dreams. Simple.	Average Length of Dreams.
1 to 10	25	0	27	0.00	1.00	5
10 " 20	34	2	55	0.00	1.70	8
20 " 30	43	11	62	0.25	1.50	12
30 " 40	42	21	69	0.50	1.60	20
40 " 50	38	32	51	0.84	1.30	30
50 " 60	29	27	41	0.90	1.40	30
60 " 70	55	68	71	1.20	1.30	30
70 " 80	34	42	58	1.20	1.70	33
80 " 90	39	56	45	1.40	1.15	43
90 " 100	44	76	48	1.70	1.00	41
100 " 120	49	88	73	1.80	1.50	42
120 " 140	54	103	69	1.90	1.30	52
140 " 160	48	103	57	2.30	1.20	52
160 " 180	44	113	56	2.60	1.30	52
180 " 200	32	81	48	2.50	1.50	64
200 " 225	31	90	37	2.90	1.20	65
225 " 250	30	91	32	3.00	1.00	72
250 " 275	26	90	43	3.40	1.70	66
275 " 300	17	54	21	3.20	1.20	83
300 " 350	23	102	19	4.40	0.80	70
350 " 400	20	83	32	4.00	1.60	88
400 " 500	17	72	17	4.20	1.00	107
500 " 900	11	47	12	4.30	1.00	140

*Rule is that ratio of dream value, as averaged for all cases, positive and negative, is 1.25 on ekbole days as compared with non-ekbole days.

TABLE SHOWING THE RATIO OF THE DREAM VALUE ON EKBOLE DAYS TO DREAM VALUE ON DAYS PRECEDING AND SUCCEEDING, AND ANALYZED WITH REFERENCE TO THE STATE OF THE "FUNDAMENTAL."

	Dream Value on Ekbole Day is Larger, *i. e.*, Rule* Affirmed. Ratio to Preceding Day.	Dream Value on Ekbole Day is Larger, *i. e.*, Rule* Affirmed. Ratio to Succeeding Day.	Dream Value is Smaller or Rule is Negatived. Ratio to Preceding Day.	Dream Value is Smaller or Rule is Negatived. Ratio to Succeeding Day.
No. Cases.	25	23	16	17
Fundamental Curve is Neutral	2.45	2.47	2.20	2.20
No. Cases.	34	20	19	23
Curve is Auxiliary.	2.90	2.61	2.27	2.06
No. Cases.	19	32	22	16
Curve is Opposing.	2.39	2.42	2.04	1.17

TABLE

Showing the variation in the power of recollecting dreams (perhaps of dream activity or vividness), as measured by the number of words in the dream record, summated for a period of 30 physiological months, from November 24, 1884, to March 13, 1887. The variation in the sexual rhythm, as indicated by the number of gonekboles, is also shown.

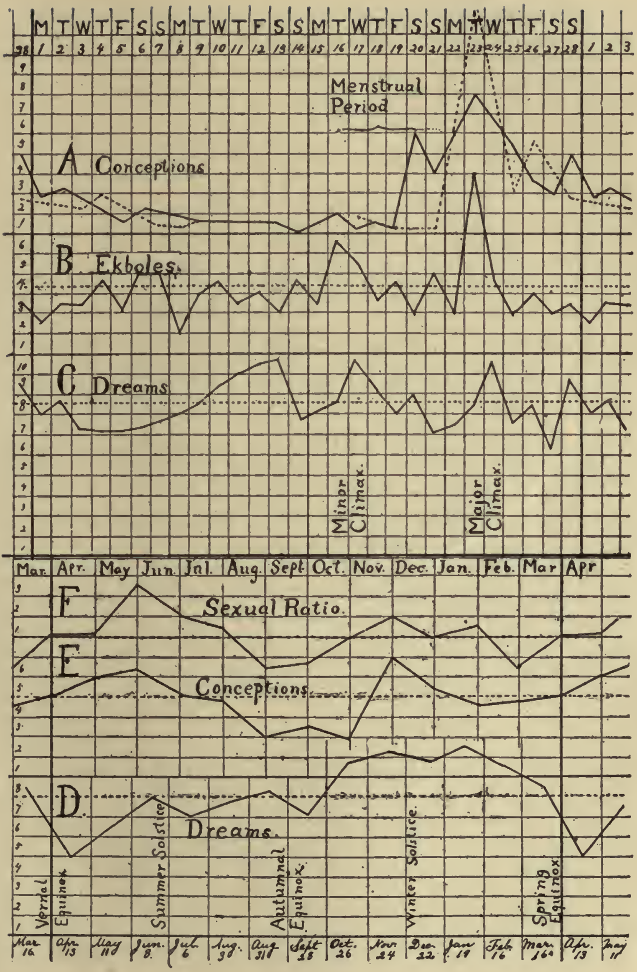
MONTHLY VARIATION.

No. of Day.	Day of Week.	Dream Value.		Sexual (Ekbole) Value.
1	Mon.	3405	Pre-climax	3
2	Tu.	3801		5
3	Wed.	3331		5
4	Th.	3192		7
5	Fri.	3152	Pre-climax	4
6	Sat.	3214		8
7	Sun.	3347		8
8	Mon.	3693		2
9	Tu.	4025		6
10	Wed.	4341		7
11	Th.	4571	Anticipatory rise	5
12	Fri.	4716		6
13	Sat.	4813		4
14	Sun.	3589		7
15	Mon.	3572		5
16	Tu.	3969	Minor Climax	11
17	Wed.	4999		9
18	Th.	4116		6
19	Fri.	3621	Here falls	7
20	Sat.	4034	the menstrual	4
21	Sun.	3135	period	8
22	Mon.	3227		4
23	Tu.	3764	Major Climax	18
24	Wed.	4741		8
25	Th.	3333		4
26	Fri.	3644		6
27	Sat.	2770		4
28	Sun.	4462		5

ANNUAL VARIATION.

No. Mo.	Month beginning.	Ekboles.	Dream Value.	
1	Nov. 24	8	4267	
2	Dec. 22	5	5090	
3	Jan. 19	3	3912	Maximum
4	Feb. 16	6	4523	17792 1st 4 mos.
5	Mar. 16	5	4159	
6	Apr. 13	5	2961	
7	May 11	3	2674	
8	June 8	1	3053	13047 2d 4 mos.
9	July 6	1	2582	
10	Aug. 3	4	3150	
11	Aug. 31	4	2746	
12	Sept. 28	4	2402	10880 3d 4 mos.
13	Oct. 26	5	5760	Total for 1885 = 47479
14	Nov. 23	7	4853	
15	Dec. 21	4	3627	Maximum
16	Jan. 18	5	5593	
17	Feb. 15	8	3827	17900 1st 4 mos.
18	Mar. 15	4	3507	
19	Apr. 12	5	1189	
20	May 10	7	2830	
21	June 7	5	3790	11316 2d 4 mos.
22	July 5	6	2534	
23	Aug. 2	6	2754	
24	Aug. 30	6	3710	
25	Sept. 27	5	2885	11883 3d 4 mos.
26	Oct. 25	6	2949	Total for 1886 = 44038
27	Nov. 22	8	4222	
28	Dec. 20	7	4581	Maximum
29	Jan. 17	5	4287	
30	Feb. 14	9	1536*	

* Owing to pressure of work, etc., the record for the 30th month was much reduced.



M T W T F S S M T W T F S S M T W T F S S M T W T F S S
A Conceptions
Menstrual Period
B Ekboles.
C Dreams
Minor Climax.
Major Climax.
Mar. Apr. May Jun. Jul. Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr
F Sexual Ratio.
E Conceptions.
D Dreams.
Vernal Equinox
Summer Solstice
Autumnal Equinox.
Winter Solstice.
Spring Equinox

THE RELATIVE LEGIBILITY OF THE SMALL LETTERS.

BY E. C. SANFORD.

When everybody reads, and some do scarcely anything else and the amount to be read increases daily, it is obviously of the highest importance that reading should be made as easy and rapid as possible. If any device of paper or ink or type can shorten the time and lessen the labor even by a very little, the aggregate advantage will far outweigh the trouble, especially as saving is to be expected at the same time in the more important matter of wear and tear on the organs employed. The problem is to get the greatest amount of matter with the greatest ease in reading on the least space; or, as it has been phrased, to get the greatest legibility to the square inch. The problem has many factors, for the result depends on the tint and quality of the paper, on the ink, on the length of the lines and the space between them, on the size of the letters, their proportions, the relation of their light and heavy lines, their distances from one another, and on still other details, all of which are small in themselves, but none of which can be neglected when the question is one of the maximum clearness. And all must be mutually adjusted with reference to the demands of taste and economy. To the typographical factors, Dr. Javal, an eminent French oculist, has devoted considerable study and experimentation, an

interesting account of which, by himself, is to be found in the *Revue Scientifique*.[1] The only other experimental research, so far as I know, which touches the question, is one by Dr. James McKeen Cattell, first published in Wundt's *Studien*;[2] the work upon the letters being incidental, however, to an extended psychometrical study. Dr. Javal tested legibility by the distance at which the letters could be read; Dr. Cattell by the number of times a letter was read right or wrong when seen for a very small fraction of a second through a narrow slit in a falling screen.

In the experiments about to be described the single factor of the letter forms was taken out for study. A standard alphabet has been carefully tested to determine the order of legibility of the letters among themselves, and the groups of letters most liable to mutual confusion. The order of legibility thus reached shows on the one hand what letters are most in need of improvement, and on the other, in a certain degree, upon what clearness depends. The distance and time tests have both been applied, though with apparatus somewhat different from that used by the investigators just mentioned. The distance experiments will be described first.

Apparatus and Methods used for the Distance Tests.

For accurate measurement of the distance a simple instrument was used. It consisted of a wooden rail 3.4 m. long placed before the subject, slanting downward at an angle of about 14°. One end came a little

[1] *Revue Scientifique*, 1881, Vol. XXVII, p. 802.

[2] *Philosophische Studien*, 1885, Bd. III, H. 1, S. 94. The same is to be found in abridged form in *Brain*, Vol. VIII, p. 295; and the part on the letters in *Science*, Vol. VII, p. 128.

below the chin of the subject when seated, the other a few inches from the floor. To the upper end was fastened at right angles a vertical board about four inches wide, and a rough profile cut in this gave support to the chin and forehead of the subject and kept his eye in a fixed position. A little wooden car sliding on the rail carried an upright of wood to which was fastened a movable disk of cardboard. The letters were pasted without natural sequence near the edge of the disk, and a black cardboard screen pierced by a square hole of 2 cm. on the side was tacked on in front. By turning the disk the letters could be shown one after another through the hole at a height above the rail equal to that of the eye. A millimeter scale pasted along the top of the rail marked the distance.

The standard letters chosen were Snellen optotypes of the size D=1.25.[1] The height of the short letters is about 1.8 mm. and of the long about 2.2 mm. The following alphabet is in type resembling that used for experiment: **a b c d e f g h i j k l m n o p q r s t u v w x y z.** The letters were cut from the optotype book with some margin about them, and neighboring letters shaved away so as to leave each letter standing alone and free from the possibly confusing shadows cast at the edge of the paper when cut near the letter. A few experiments were made upon letters from *Mind*, but for them this precaution was not taken, and the screen used was white instead of black. There was nothing in the setting of the letters on the disk to show which extended above and below the alignment except the remnants of a faint pencil line, which, as will appear in the tables, had little or no effect.

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[1] The formula D=1.25 means that the letters are of such a size that the short ones subtend an angle of 5′ at a distance from the eye of 1.25 m.

The illumination was as far as possible that of the clear sky. Some alphabets were taken with light of less than full intensity ; but in almost every case the illumination was the same for the whole of each, so that no error is to be expected in the *relative* determination aimed at.

Of the five subjects, four were graduate students and one a recent doctor of this University. They will be designated by the initials A, B, H, J, and M. H and A are quite far sighted, J moderately so, B may be taken as normal, while M is near sighted, but by the use of his glasses read at distances not very different from those of B.

Legibility for distance was measured in two ways. By the first the letter-disk was set at fixed distances and the whole alphabet shown in general twice or more at each distance. The first distance used for H, M, and B was 1.5 m., and this was increased 10 cm. at a time till a distance of 3.2 m. was reached. The distances were then correspondingly decreased till all the letters could be read. J went only down the scale from 1.6 m. to 3.2 m., and A only up from 3.2 m. to 1.8 m., after having first seen the letters at a comfortable reading distance. In taking the record the subject announced, when the letter was shown, what he supposed it to be, and his answer was recorded ; if he were in doubt he gave the possible letters in what he supposed to be the order of probability, unless all seemed equally probable. In the case of H one other answer was allowed for letters that had become indistinguishable by distance, namely: "One of the small letters ; no preference." This method gives us the order of legibility as shown by the number of times each letter was rightly or wrongly named, all distances being taken

together, and at the same time the letters with which each is most confusable when the confusion is caused by distance. These things appear in the following tables.

RESULTS BY THE FIRST METHOD FOR DISTANCE.

TABLE I.

Order of Letters as shown by Percentages of Right Answers.

m 90.9	v 71.0	x 63.0	n 46.2
w 88.1	k 70.9	a 60.8	e 46.2
f 84.4	b 70.4	i 60.6	c 45.1
p 84.3	y 70.4	l 58.6	o 44.9
q 80.9	h 69.9	u 55.2	z 34.1
r 78.7	d 68.3	s 53.0	
j 77.6	g 68.2	t 46.5	

The numbers in Table I are percentages on a total number of answers varying from 291 to 313. The full records of H, M, A, and J were included, and that of B in going down the scale from 1.5 m. to 3.2 m. In the cases of doubt where the answer contained several letters, the letter recorded as having the greatest probability was counted as if it had stood alone, on the ground that if but one letter had been allowed in the answer that would have been the one. Where no difference in probability was recorded, the answer, even when containing the right letter, was counted wrong.[1]

[1] The latter half of B's record was excluded because it shows a large proportion of answers in certain fixed forms: for example, "b or h" for both b and h, or "c or e" for c, e, and o. This came, as B himself recognized later, from his having unintentionally ceased when the letters were almost indistinguishable to report a preference for the one or the other, the single answer being made for all letters of a certain degree of indistinctness. There were five of these forms pretty well marked; "b or h," "c or e," "i or l," "u or n," and "x or z," ease of pronunciation seeming to have fixed the order of letters in the answers, except the last. The part of B's record included in Table I was also, though to a less degree, influenced by the same tendency, and the result would have been, if the answers had

TABLE II.

Showing the Confusability of the Letters as tested by Distance.

m	29	w 52, u 24, n 10, a 7, * 7
w	34	v 53, u 12, m o 6, * 24
f	49	r 37, l 20, j 16, t 10, i 6, * 10
p	36	r 44, y 17, j q 8, g t 6, * 11
q	54	g 30, z 19, s x 7, c n u 6, * 20
r	49	v 22, f 12, s t y 8, c o 6, * 29
j	57	l 25, f 21, i 18, t 12, c 5, * 19
v	61	r 33, t 11, e 8, q 7, * 41
k	88	x 34, h 12, g 11, a 10, b 8, d 6, * 18
b	77	h 45, k 14, a u 10, n 8, * 12
y	69	p 61, r 29, f 6, * 4
h	91	b 51, k 40, * 10
d	69	a g 22, n 9, k o 7, * 33
g	73	r 12, t 10, f 8, a 7, d j o s u 5, * 36
x	96	n 19, z 15, a 9, k w 7, g m o 6, * 24
a	100	u 16, n 14, s 13, k 12, b 9, h 8, e 6, z 5, * 17
i	117	l 58, t 21, j 9, * 12
l	113	i 39, j 36, t 7, f 5, * 12
u	115	a 18, z 12, x 9, n v 8, s 7, g 6, b k o 5, * 17
s	105	n 14, c r 12, i 10, e 9, o v 8, a u 7, * 13
t	129	i 40, s 9, d 8, x 7, l 6, * 31
n	144	a 41, z 12, b 6, h 6, * 35
e	144	c 40, s 11, v 8, r 7, u 6, * 27
c	146	e 34, o 23, u 10, v 9, * 24
o	151	c 34, e 23, a 13, u 11, n 5, * 14
z	144	e 19, s 17, a 16, t 9, o 8, c 8, g 6, * 17

Table II will not be found to tally exactly with Table I, because B's record was here entirely excluded and because all the alternates in cases of doubt are counted in, the object here being solely to show the confusables and their proportionate confusability. The figures as before are percentages, except in the column next the

---

been counted as those of the other men, to give a disproportionate number of right answers to the letter standing first, and a disproportionate number of errors to that standing last. By way of correction, one half of the number of fixed answers for each letter has been applied positively or negatively as necessary to the letters affected, except to the letter o where one third was used instead. The addition of B's record so corrected to that of the other observers changed the order of letters only as follows: k advanced from behind d to before b, and u and s, q and r, and o and e changed places. The letter d would perhaps have stood a little higher in the list had not B suffered a certain inertia in answering "x or z" for it; this error was not, however, such as could be safely corrected.

letters, where is given the actual number of errors and alternates upon which the percentages are calculated. Letters appearing in the record less frequently than five per cent of these numbers have been regarded as scattering errors and only the percentage of them all together has been given. Scattering errors are indicated by the asterisk. No great weight is attached to many of the confusions which occur more than five per cent of the times, because of the possibility of habit in answering, as explained in the note above.

The Second Method of Distance Determinations.

This method was intended partly to be a check upon the first and partly to fix more accurately the distances at which the letters are just legible. The plan here was to set the car at the bottom of the rail, or beyond the point at which the letter in question could be distinguished, and to have the subject draw it slowly toward him till he was sure what the letter was. Two distances were generally recorded; one the point at which the subject first thought he knew the letter; the other, the point at which he was certain. H, J, and M were tested in this way with the Snellen letters; H and M going over the alphabet ten times each, J five times. Early in the experimentation B and M were thus tested with the letters from *Mind*, B giving eight alphabets, M four.

Owing to the differences of individual eyesight, this method does not give results that can be gathered up in a single table, but the following tables for the single subjects, together with the curves which accompany them, give some means of comparison.

RESULTS BY THE SECOND METHOD FOR DISTANCE.

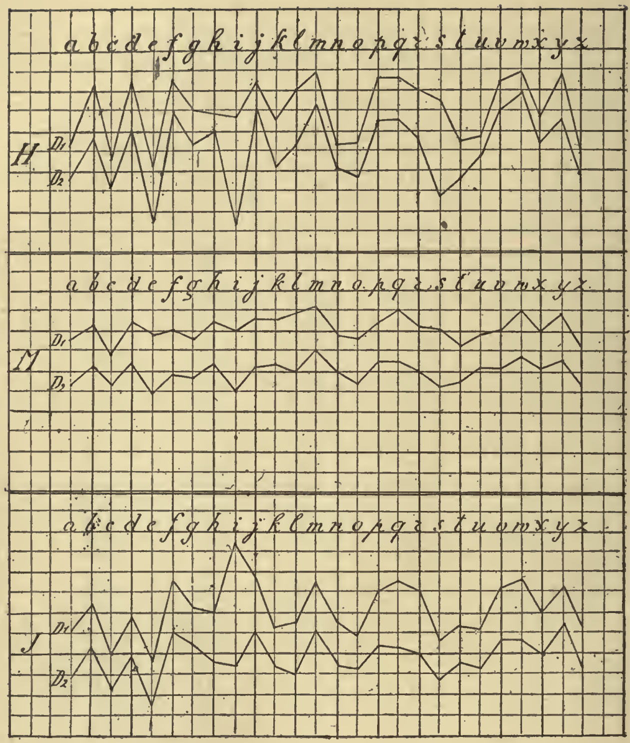
TABLE III.

Showing the Distances in Meters at which the Snellen Letters were recognized with certainty by H, M, and J.

	H.		M.		J.	
	D_2.	M. V.	D_2.	M. V.	D_2.	M. V.
a	1.877	.095	1.326	.122	1.185	.153
b	2.400	.100	1.564	.147	1.560	.117
c	1.788	.113	1.336	.151	1.064	.087
d	2.539	.074	1.593	.166	1.449	.078
e	1.364	.104	1.223	.114	.820	.049
f	2.727	.260	1.450	.110	1.745	.047
g	2.310	.188	1.396	.118	1.628	.111
h	2.473	.136	1.594	.146	1.394	.075
i	1.324	.073	1.262	.139	1.345	.251
j	2.768	.203	1.551	.169	1.722	.107
k	2.076	.151	1.574	.160	1.353	.121
l	2.333	.321	1.499	.176	1.251	.081
m	2.842	.267	1.758	.188	1.778	.131
n	2.049	.116	1.538	.101	1.366	.079
o	1.912	.053	1.334	.114	1.322	.066
p	2.605	.130	1.622	.132	1.588	.116
q	2.628	.124	1.626	.148	1.591	.226
r	2.365	.176	1.505	.139	1.508	.140
s	1.662	.130	1.327	.156	1.181	.048
t	1.856	.068	1.374	.175	1.358	.045
u	2.153	.098	1.545	.171	1.329	.084
v	2.725	.119	1.561	.114	1.703	.125
w	2.953	.206	1.678	.147	1.707	.150
x	2.339	.069	1.553	.124	1.524	.070
y	2.639	.182	1.642	.141	1.852	.122
z	1.940	.116	1.317	.100	1.287	.142

In Table III the columns headed D_2 give the average distances, expressed in meters, at which the letters were recognized with certainty; those headed M. V. give the mean variation of the single quantities entering the averages after which they stand.[1]

[1] The mean variation is found by averaging the variations of the single quantities from the mean, no account being taken of whether the variation is positive or negative.



See note, p. 435.

In these curves the ordinates are averages of distances drawn to a scale of about $\frac{1}{70}$. The curves marked D_1 are those for the distances at which the subject would first venture an answer and did actually answer correctly; those marked D_2 are for the distances at which he knew the letter with certainty, and correspond to the columns similarly marked in Table III. For the letters from *Mind* only the certainty distance was recorded. The separation of the curves D_1 and D_2 for any letter indicates the distance through which the letter had to be drawn to bring the subject from a minimal degree of confidence to certainty. It is the zone in which the letter would in general be guessed correctly. In the case of H this zone would probably have been wider for some of the most legible letters but for the fact that he read them with a certain degree of confidence at the extreme limit of the apparatus.

Comparison of the Results of the Two Methods for Distance.

To facilitate comparison, the orders of legibility for distance arrived at by the two methods are here given:

From Table I,

m w f p q r j v k b y h d g x a i l u s t n e c o z.

From Table III,

H. w m j f v y q p d h b r x l g u k n z o a t c s e i
M. m w y q p h d k b v x j u n r l f g t c o s a z i e
J. y m f j w v g q p b x r d h n t k i u o z l a s c e

Letters from *Mind*,

B. d p q m y k n w o g v x h b j l i a t u z r s c f e
M. m q o p h b n v y u d i w k g j r t x a c z l f s e

It will be seen that there is a general agreement in the orders; but at the same time there are some

differences. A perfect agreement is hardly to be expected. As between the order of Table I and those of Table III, a part of the difference is caused by difference in the method of computation. Table I being made from the united answers of a whole series of distances, letters like i which have a wide zone in which they tend more or less to be correctly named would have the advantage of letters like u and n which have a narrower one. For Table III, however, width of zone counts nothing at all. Furthermore, it is not impossible that Table I is still slightly affected by fixed answer forms too little marked to be open to correction; and both tables would be affected, and probably in different degrees, by fixed letter preferences, if any such existed in the minds of the subjects.

The differences of H, M, and J among themselves are in part the result perhaps of optical differences, and in part of differences in the points by which the letters were recognized. H and M, as they have told me, fixed upon the white place between the stem and dot of the i as the sign by which to distinguish it from l, and to see this clearly were obliged to bring the letter quite near; but J trusted to the general smallness of the letter, and this proved at least for him a reliable sign, for he recognized i farther and named it correctly a greater proportion of times than H or M. Something similar may have happened with other letters, though the question has not been investigated.

Another factor which operated probably to a certain extent in both the methods was, strange as it may seem, defective memory of the alphabet. Something more will be said of this in another connection, but it will suffice to say here that all the letters do not seem to be all the time equally present in the mind of the

subject. One or another may fall out for a time and so not be considered in deciding how to name a barely visible letter.

Between the orders for the Snellen letters and those for the letters from *Mind* we may look for differences due to the forms of the letters, the latter being relatively longer and slimmer and having the upward and downward extensions of the long letters about one half the height of the small letters instead of about one fourth as in the case of the optotypes. Taking H's order for the Snellen letters, which is in substantial agreement with that of one or the other of his colleagues for nearly every letter, and B's for the letters from *Mind*, it will be seen that in the latter d, p, q, k, n, o, g and i are advanced; while f and j are set far back, and in a less degree r, w, u and v. The increased length accounts for the advancement of the long letters. The long letters not advanced, except f and j, are b, h, l and y. But y stands already near the head of the list and the other three may be kept back by possible confusions; b and h with each other, and l with i. The i is improved by the increase in height, having more space between its stem and dot. The n and o perhaps are favored by finer lines and larger internal areas of white, but why u should not then be advanced too remains unexplained. The f and j, and perhaps the v, r and w, owe their low position to their narrowness. The orders for B and M are at variance between themselves, and the only value of the latter is the slightly confirmatory one of its agreement with that of B in the advancement of i and the setting back of f, j and w.

So much for disagreements; let us now consider the concurrences. If we divide each series into

three groups of eight, ten, and eight each, we may call those in the left group good, those in the central group fair, and those in the right group poor letters. All the orders from the Snellen letters agree in setting w, m and q in the left, b and x in the central, and z, o, c, s and e in the right group. If we now add to each group those letters that fall in it three times in four we shall have the left group increased by j, f, v, y and p, the central by d, h, r, l, g, k and n, and the right by a and t. Two letters, u and i, occur twice in the central and twice in the right group, but the u's in the central stand third and sixth from the line of division, those in the right section first; the i's, on the contrary, stand only first and second in the central section, but seventh and eighth in the right. We may then fairly put i among the poor letters and u among the fair. This gives us as the final classification w, m, q, p, v, y, j and f as good; h, r, d, g, k, b, x, l, n and u as fair, and a, t, i, z, o, c, s and e as poor.

Relative Legibility and Confusability by the Time Tests.

Methods and Apparatus.

The time test was of the same nature as the first distance test. A certain fraction of a second was chosen, generally between two and six one-thousandths, and the letters were each shown several times for that interval, then another fraction of a second was chosen and the showing repeated and so on. The degree of legibility appears as before in the percentage of correct answers, all the stages being taken together.

The exhibition of the letters for such short periods requires more complicated apparatus than that employed for distance. After some trials of other ar-

rangements the letters were finally set in a dark box and the length of their exhibition controlled by the length of an artificial illumination.[1] The critical point, however, in all such experiments is the measuring machine, and various plans were tried till a happy suggestion of Professor Hall's led to the working out of the instrument used. This has proved in some respects so satisfactory that I shall venture a rather full description of it.

The illumination is controlled by the passage of corresponding notches in overlapping disks driven by a pendulum. The pendulum swings between T-shaped iron columns cast in one piece with the heavy base upon which they stand. The pendulum rod is a steel bar two feet long, an inch and a quarter wide and a half inch thick, and the bob is a lens of lead nearly six inches in diameter. Together they weigh about twenty-three pounds. The shaft upon which the pendulum swings is set in bearings that allow the pendulum to turn clear round over and over. On the same shaft, fastened securely to the pendulum rod, is a brass cogwheel eleven and three-quarter inches in diameter and a half an inch thick. This wheel has 144 teeth and works on each side into a little wheel, less than an inch in diameter, having twelve teeth. The little wheels therefore make twelve turns to every complete turn of the large one. The shafts of the little wheels

[1] The apparatus used by Dr. Cattell has the merit of great simplicity. But the width of the slit in the falling screen through which the letter appeared seems to have been less in the most part of his experiments than the height of the long letters of the type used. Moreover, where room must be left for the movement of a screen before the letter, the eye cannot be perfectly adjusted for distance. In Dr. Cattell's apparatus this was only 3 mm., but under favorable circumstances binocular double images can be gotten from objects 3 mm. apart at a distance of eight or ten inches. The aim of the arrangement adopted was to avoid these difficulties.

run through the ends of the arms of the forward T-column and end in flat brass disks four inches in diameter. The overlapping disks that regulate the illumination are clamped upon these by other free disks of brass which go on in front and are held in position by nuts that screw on to posts in the middle of the first mentioned disks. The overlapping disks are thirteen and three-quarter inches in diameter and of cardboard. As the pendulum swings these two disks move in a direction contrary to its motion and so both in the same direction. Their overlapping sides, therefore, the left side of the right disk and the right side of the left, move in opposite directions; when one moves up, the other moves down, and *vice versa*.

By means of two inclined mirrors the light is caused to pass from behind toward the overlapping edges of these disks. Every time, therefore, that the notches in the disks coincide, the light will shine through for a length of time depending on the width of the notches and the rate of the disks. For every complete circuit of the pendulum, however, there would be twelve coincidences and twelve flashes of light, were not all but the shortest one cut off by another disk behind these two. This is about seven inches in diameter and is moved at the same angular rate as the pendulum by a set of two and a half inch gears, one on the main shaft of the pendulum and one on the shaft of the disk. A notch in its edge allows the light to pass during that portion of the circuit of the pendulum in which the shortest coincidence of the notches of the large disks occurs, and cuts it off at all other times.

The rate of the pendulum, and with it the angular rate of the disks, is kept constant from one fall to another by letting the pendulum start each time from

a fixed point. For this purpose a stout plank is fastened to the rearward column, and near its top, but a little to one side, is fastened a trigger catch. In using the machine the pendulum is brought up into position against the catch and the trigger pulled; it then falls with great swiftness and rises again on the opposite side of its arc to a nearly vertical position, where it is caught by the hand and pushed on till it rests again on the catch and is ready for another fall. Since, then, the rate of the disks is the same each time, the length of the illuminating flash can be varied by varying the width of the notches. It would no doubt have been possible to use permanent disks with some mechanical device for opening and closing the notches, or to have reached the same end by dropping the pendulum from different points on its arc, but it seemed better in this study to make a number of sets of disks with notches of varying width and to change the length of the flash by changing the disks. The accompanying cuts will help to make clear the construction of the machine.[1]

The width to be given to the notches for any particular fraction of a second is measured by making a tuning-fork write upon smoked paper fastened upon the brass disk mentioned above as clamping the cardboard disks. The fork is attached to the armature of an electro-magnet and the pendulum can be made to close and open the circuit in its fall. The fork is thus made to write for a little more than a single turn of the disk, the turn chosen being that in which falls the illuminating flash. In this way it was found that this turn of the disk is made in less than 0.07 of a second, and that an angle whose arc measures ten eighths of an inch on a circle thirteen inches in diameter is passed over in about one five-hundredth of a second; or, since the overlap-

[1] See pages 418 and 435.

Fig. I.

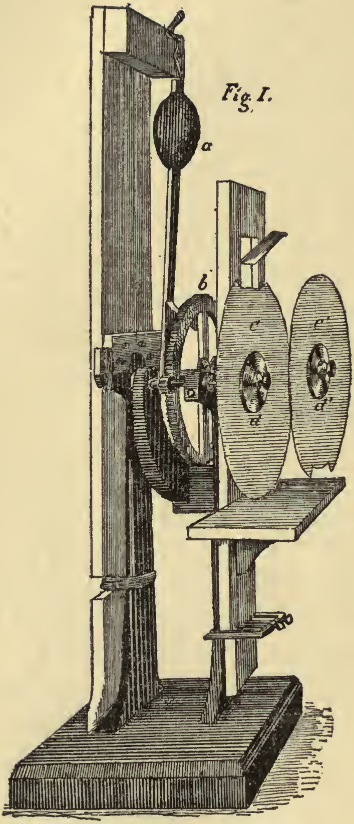
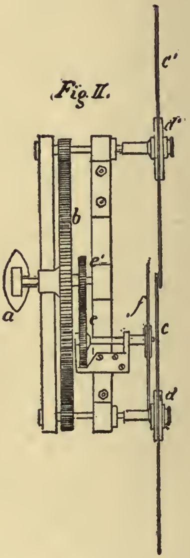


Fig. II.



ping edges of the disks move in opposite directions with equal speed, notches of this width in both will pass one another in one one-thousandth of a second. From this as a unit any required interval may be laid off; for the rate of the disks is sensibly constant for several consecutive thousandths of a second. A certain error was to be expected from the play of the wheels when the pendulum crossed the lowest point of its arc. This might have been avoided by making the coincidence

of the notches come before the pendulum reached that point, but in the first tracings taken the error was hardly noticeable. The extreme variation from all causes in that part of the turn covered by the notches, as estimated from 81 tracings taken at different times during the experimenting, was about one part in eighteen. The instrument might, perhaps, be criticized on the ground of its noise, but this is a constant factor and the subject soon becomes completely oblivious to it.

The dark box was of simple construction, about fifteen inches square and nine deep, and was set obliquely before the machine. The letters were pasted as before on a cardboard disk, and were immediately behind a centimeter square opening in a black cardboard screen at the back of the box. The disk could be turned from behind through a hole in the box. The place of the letter was indicated by pinholes pricked near it; at first by four, later by three. The illuminating flash entered the box by a cardboard tube and fell on the letters at an angle of about 40°, while the subject looked perpendicularly upon them at a distance of sixteen inches. A certain quantity of extraneous light entered the box in various ways, sufficient often to make the white square about the letter dimly visible to eyes thoroughly accustomed to the dark, but never, of course, sufficient to disclose the letter.

The light used for the illuminating flash was from a free-burning gas-jet re-enforced by a plane reflector. The total distance traversed by the light in reaching the letters was about three and one half feet, and in its course it was twice reflected. Its intensity was therefore not great, but that is of little consequence in the present instance. A more serious disadvantage was

the quivering of the flame, which was an undoubted cause of variation in the reading of the letters, but the number of exhibitions of each letter makes its effect inconsiderable in the final result.

As before, the Snellen letters were those most thoroughly tested; the tables for them rest upon a basis of two hundred exhibitions of each letter. A second set of letters of nearly the same dimensions, but of somewhat different shape (heavy faced old style), and including as extra forms the small capitals A, E, L, and T, and a long s, was exhibited eighty times.

The following alphabet is in type like that used, but smaller:

a	b	c	d	e	f	g	h	i
j	k	l	m	n	o	p	q	r
s	t	u	v	w	x	y	z	

The small capital A was made by inverting a V; the E had its backward extensions trimmed away; and the T, L, and long s were made from parts of other letters, the latter from the tails of two j's.

The subjects were doctors and graduate students of this institution, except C, who is a boy about fourteen years old. The number of alphabets furnished by each was as follows: For the Snellen letters, C, 5; H, 38; J. H, 18; J, 23; L, 45; M, 26; S, 21; U, 24; and for the other alphabet, H, 11; J. H, 12; J, 12; L, 11; M, 12; S, 13; U, 9. The lengths of time for which the letters were exhibited varied with the individual; records taken with H, for example, from 0.0013s. to 0.004s. are included in the table for the optotypes, and with J from 0.002s. to 0.006s.[1]

[1]Absolute exactness is not attached to these times, though they are approximately correct. It is sufficient for the purposes in view that the time should be the same for each letter of the alphabet. As measured by the width of the notches the figures are probably slightly too small; but, on the other hand, while the notches are passing each

Results by the Time Method.

Table IV corresponds to Table I, except that the percentages of wrong answers and of the times when no answer was ventured are added.

TABLE IV.

Snellen letters:

	Right.	No Answer.	Wrong.		Right.	No Answer.	Wrong.		Right.	No Answer.	Wrong.
m	82	7	10	f	58	6	36	o	39	17	43
w	73	1	25	b	52	11	36	u	38	13	48
d	67	7	25	l	49	8	42	a	35	15	49
q	66	5	28	i	48	15	36	n	34	8	58
v	63	7	29	g	47	13	39	e	33	20	46
y	62	5	32	h	47	9	43	s	27	21	51
j	61	12	26	r	43	11	45	c	26	14	60
p	61	7	31	x	42	16	41	z	23	19	57
k	61	7	32	t	39	15	45				

Old style letters:

	Right.	No Answer.	Wrong.		Right.	No Answer.	Wrong.		Right.	No Answer.	Wrong.
m	90	2	7	j	56	6	37	a	32	21	46
w	82	6	11	r	55	7	37	t	31	16	52
p	79	1	20	l	54	10	36	f	30	20	50
q	74	10	16	o	52	14	34	s	29	24	47
v	70	7	22	n	45	14	41	x	29	21	50
y	67	5	27	i	42	16	41	z	27	24	49
k	64	2	34	g	41	22	36	c	26	29	45
b	61	16	22	h	40	10	50	e	14	24	62
d	56	17	26	u	37	16	46				
ſ	45	9	46	L	22	31	46	E	5	26	69
A	39	15	46	T	6	20	74				

other, the chink through which the light shines opens from nothing to the full width of the notches and then closes to nothing again, thus giving at one end of the interval a phase of increasing and at the other of decreasing light, which would shorten by a small amount the time for which the letter is really visible.

Dr. Cattell found with his apparatus and letters of the same size that half of the alphabet was read correctly with an exposure of from 0.0011s. to 0.00135s.; in this study it was found that from 0.0017s. to 0.004s. or 0.005s. was necessary for an equal proportion of correct

Table V corresponds to Table II in calculation and arrangement.

TABLE V.

Snellen letters:

a	116	n 18, s u 14, e 11, g 6, c z 5, * 24 .	n	130	a 34, u 14, q 6, h 5, * 41
b	85	h 24, a 11, n k 8, o 5, * 41	o	105	e 32, c 26, a 9, q 7, * 27
c	140	o 25, e 24, r 6, * 44	p	70	y 17, g 14, q 10, b e n o 6, * 36
d	57	a 28, g n 7, l m q u 5, * 37	q	69	d g 14, o 13, a 9, b c n s u 6, * 20
e	113	o 25, c 16, d 8, g 7, v s 5, * 33	r	100	y 14, f g 12, p t v 8, i 7, z 5, * 26
f	84	l 21, i t 14, r 13, j 8, g 6, * 27	s	121	a 19, e 14, o z 11, g 8, * 37
g	90	a s 17, z 12, k 9, d 8, x 6, * 32	t	112	i 28, l 18, f 11, j 9, r 8, y 5, * 21
h	101	b 44, k 13, a 10, n 8, * 26	u	109	n 21, a 19, e 9, c 7, * 43
i	87	l 39, t 17, j d 9, * 25	v	71	r 25, y 18, e w z 6, * 39
j	62	l 47, d 11, i 10, g 8, y 6, * 18	w	55	v 16, n r 9, a g u 7, e m s 5, * 27
k	69	h 20, g 12, x 10, a 9, y 7, n 6, * 36	x	91	k z 20, n 12, a 10, g 7, * 32
l	97	i 44, j 19, t 8, d y 6, * 16	y	71	g p 15, r 14, q 11, v 8, f 7, * 28
m	28	o w 18, a e 14, k n x 7, * 14	z	124	s 23, g 17, a 12, x 8, k 7, * 34

Old style letters:

a	46	n 17, u 11, o 9, c d e s x 7, * 30	n	37	p 19, a 16, u 11, o 8, b q r s t 5, * 19
b	23	h 26, k p 13, t u 9, * 30	o	33	e 27, c 15, a b p 9, x z 6, * 18
c	40	e 15, r 10, g k t 8, a n u E 5, * 33	p	17	g E 18, q 12, b e i l r t u w ſ 6
d	21	a 19, j 14, g l u 10, * 38	q	16	o 19, c s E 13, d e g r u v A 6
e	53	c 24, r 9, n s z 8, u 6, * 38	r	34	f 35, i v 18, l 6, * 24
f	41	i 24, l 17, ſ 15, j 12, t 10, * 22	s	45	a 16, n 13, c z 11, e x 9, g h 7, * 18
g	34	n 15, z 12, a h E 9, d g q x 6, * 24	t	45	i 27, l 22, f 11, j 9, k 7, * 24
h	50	b n 32, p 8, * 28	u	48	n 19, c o 15, e 10, b 8, z E 6, * 2[illegible]
i	37	l 30, j 27, t 24, f 11, d 8	v	23	w 22, o 17, y 13, c e q 9, * 22
j	35	l 40, ſ 26, i 20, * 14	w	10	E 30, a 20, m n o u v 10
k	37	h 22, t 16, b l s 8, f g l 5, * 22	x	45	z 18, k 13, a 11, s 9, v 7, * 42
l	31	i 35, j 29, t 16, f z 6, * 6	y	25	v 28, p 20, n u 8, * 36
m	8	w 50, e n z L 13	z	44	x 20, s v 9, g r y 7, * 41
A	42	a 38, e 12, c n 7, * 36	ſ	40	j 40, f 28, l 15, i t 5, * 8
E	61	a 11, m 10, s z 8, g k r 7, * 42	T	64	r 55, v 8, l t y 6, * 19
L	41	t 27, b 22, * 51			

answers. Two reasons for this difference are clear, namely, that the illumination used here was much fainter, and that the retinas of the subject were each time before the illumination in an approximately unstimulated condition (*vide* Wundt, *Phys. Psych.* 3 Aufl. II, 267). There is, moreover, a peculiarity in Dr. Cattell's apparatus which may render the figures less comparable than might at first appear. The slit in his falling screen had to be 1.3 mm. wide to pass over a given point in 0.001s. The long letters are, however, 2.2 mm. high, and the length of time from the instant in which the top of the letter first became visible to that in which the bottom of the letter ceased to be visible must have been 0.001s. plus the length of time required to pass over the letter, which was about 0.0017s. Any particular point of the letter was therefore seen for 0.001s., but the whole letter was in the process of being seen for 0.0027s.

These tables are subject to the same disturbing influences and therefore to the same criticisms as their parallels for distance, and as before, some of the confusions represented as possible owe their prominence to individual peculiarities of the subjects.[1]

The order of legibility for time, in spite of some variations, is in substantial agreement with that for distance. For the sake of comparison these are given below, together with that given by Dr. Cattell.

Order for time, Snellen letters,

m w d q v y j p   k f b l i g h r x t   o u a n e s c z

Order for distance, Snellen letters, combined result,

w m q p v y j f   h r d g k b x l n u   a t i z o c s e

Order for time, old style letters,

m w p q v y k b   d j r l o n i g h u   a t f s x z c e

Order for distance, letters from *Mind*, B's record,

d p q m y k n w   o g v x h b j l i a   t u z r s c f e

Order of letters for time, given by Dr. Cattell,

d k m q h b p w   u l j t v z r o f n   a x y e i g c s.

By a strange bit of perversity several of the worst letters fall in the number of those most frequently used. In a full font of type the eight letters most largely represented are as follows:

e 12000	a 8500	n 8000	s 8000
t 9000	i 8000	o 8000	h 6400

[1] Another test of legibility would be to present the letters to the eye in indirect vision. This is especially worthy of trial because in normal reading the eye does not pass at a uniform rate from letter to letter, but flits from word to word, almost from phrase to phrase, judging many letters in the indirect field. It is hardly probable, however, that it would show results essentially different from those for distance and time. The connection of rapidity in reading and the indirect field has been demonstrated by the experiments of Dr. Cattell, *Mind*, Vol. XI, p. 64.

What Points of Form Help and What Hinder Legibility.

It can be said *a priori* that legibility will be favored by enlarging the size and increasing the differences of the letters. And it is easy to show also that legibility is favored by simplicity of outline and concentration of the differentiations upon one particular. The influence of size is clear from the composition of the left groups in the alphabets of the last section, where it also appears that breadth is as great an advantage as length. With most of the letters breadth is rather more of an advantage, other things being equal, than length, for it gives some visibility to their internal spaces; and Dr. Javal is undoubtedly right in prefering short broad letters to long and narrow ones. The differences necessary to legibility have been neglected by the makers of phonetic alphabets, in their desire to indicate phonetic similarity by similarity of form. If such alphabets are ever to come into general use they will certainly have to be improved in this respect. Simplicity of outline, or what is the same thing, solid areas of black and white, will be found in most of the letters of the left groups. It may even compensate for small size, as is shown by the legibility of v. In accordance with this principle, the ceriphs, or little finishing strokes of the letters, for example at the top and bottom of h and the ends of s and z, should, as Javal recommends, be made short and rather triangular than linear in shape. They are really more important in protecting the tips of the letter from the rounding effects of irradiation than in giving it a finished appearance, and should therefore be as small as possible and yet accomplish that object. When they are too long, as is certainly the case with the Snellen letters, they

easily lend themselves to confusion. The concentration of differentia is well seen in the group b d p q, where each of the letters is made of a straight stem and a loop, the whole difference being made in combining the two. All are very legible letters except b, which suffers from confusability with h.[1] An example of lack of concentration is found in g and a, which have few points in common with other letters and yet are mistaken for many different ones.

The element of size cannot be used to improve the relatively poor letters without at the same time shocking taste and opening the way for new confusions. It is therefore from simplification and emphasis of the points of difference that help is to be expected. In the c e o group, for example, the point of distinction of c and e from o is the gap in the side, and Javal is right in proposing a return to the more open forms of the earlier type-founders. He suggests two forms for e; one like that in the "old style" letters above with the cross line near the top, and one in which the cross line is made longer and more prominent by an oblique position, thus, *e*. It would appear from Table V that the first of these is about as confusable with c as the common form is. The advantage of the wider openings of the c and e appears in the less percentage of confusion with o, as shown by a comparison of the second part of Table V with the first and with Table II. The two forms of the Greek epsilon, ϵ and ε, and an E, made with square corners like the capital to distinguish it from c, suggest themselves as possible substitutes. The result of the tests for the latter is given in the

[1] The difficulty which has made a proverb of "Mind your p's and q's" is the difficulty of naming each correctly, and not that of recognizing their forms as different.

second part of Table IV, where its extreme illegibility is strikingly demonstrated. All the letters added suffered somewhat from ignorance on the part of the subject of their exact form and from a tendency to let them drop out of memory in answering, but E is the worst of the five. In Dr. Cattell's experiments on the capital letters E proved worst of all.

Another group of the poor letters includes a, n, and u. The distinction of n and u from each other and from a ought to be helped by keeping their openings at the top and bottom as open as possible, and the slight advantage shown in this particular by the second half of Table V over the first may be due to the wider openings of the "old style" letters. Dr. Javal points out the curved top of the a as a point of resemblance to n and recommends a form of the first letter found in the Italian manuscripts that furnished the model for some of the early typemakers. In this the top is very small and the loop is relatively long horizontally, giving the letter the appearance at a distance of an inverted r : ɹ. Even in the less exaggerated form which the letter would be given if it were adopted, it could easily be distinguished from u and n; and from s also, with which it has some tendency to confusion. The great legibility of v suggested that its inverted form, small capital ᴀ, might be substituted (after the analogy of c, o, s, v, w, x, and z) for the present a, and it was tested with the "old style" letters. Table V shows a slight advantage for it in spite of the handicap of the added letters. Strangely enough, the letter with which it was most frequently confused was the a-form now in use; had that been omitted it might have stood considerably higher in the list.

Dr. Cattell says that s is "hard to see"; and the

number of times no answer at all was ventured for it, together with the wide scattering of its confusions, show him to be right. Dr. Javal, too, thinks it rather a hopeless case, but suggests the sharpening of its angles as a way of making it approach the legibility of z. In the s of the "old style" alphabet this has been done to a certain degree and the letter made relatively a little larger. As long as the present form is retained something of this kind is probably all that can be done. Tests were made, however, on a long *ſ* with the satisfactory results shown in Table V. The long s that is so much like f should of course be avoided, but great legibility is to be expected from a form that extends both above and below the line; it would at least put confusions with z and a out of the question.

The group with which this form of s is most prone to confusion is the long, narrow group, f, j, i, l, t. Of these f and j are good letters when the projections at the top of one and the bottom of the other are made heavy and long enough, as shown by the superiority of the Snellen f and j over the same letters in the alphabet from *Mind*. It is preferable if the s confusion is to fall anywhere that it should be on these letters rather than on a and z. The other letters of the group are not nearly so liable to confusion with the long s as with each other. Dr. Cattell suggests λ for l and suppression of the dot of the i. Dr. Javal would shorten the t and prolong its cross toward the left (this, however, chiefly to distinguish it from f, the cross of which is to be prolonged the other way); and he would set the dot of the i as high above the stem as possible, at the same time making it heavy to avoid breakage, and thickening the stem to match. The value of Dr. Cattell's suggestion for l is doubtful. The letter suggested

is totally foreign to our Roman alphabet, and very possibly would be confusable with b and h as y is with p. Removing the dot from the i would certainly make it more legible when standing alone, but much more confusable when with other letters in a word. Twice when for a few weeks I had the matter in mind, my attention was called to i's in print accidentally deprived of their dots; in one case l and i together made a tolerable h; in the other the loss of the dot turned "ruin" into "rum." The small capital forms for L and T were put to the test with unsatisfactory results, partly due perhaps to the fact that the letters were made from parts of other letters set together. The t difficulty could probably be solved as Javal suggests, and the distinctive point of the i, the separation between the dot and stem, could be emphasized by making the stem shorter than the rest of the short letters, though this would hardly be tolerated from an æsthetic point of view.

The confusion of x and z and of s and z would be lessened by reducing the ceriphs to the lowest possible limits.[1]

Into the remaining confusions of Tables II and V it is hardly profitable to go, but it may be added as explanatory of some of them that a difference of size was

[1] If acceptability is entirely neglected, it is not hard to suggest geometric forms of great probable clearness to replace some of the forms of the present alphabet. A cipher alphabet which fulfils the conditions in a high degree is found on page 291 of the *Revue Scientifique*, Sept. 3, 1887, where it is attributed to the Freemasons, though the same has been shown the writer as once current among the pupils of an American school. The letters are all made from the lines and spaces of the set of crossing parallels used in playing "tit-tat-to" together with an ×; the upper left hand angle giving a, the same with a dot in it b; the next three-sided square standing for c, or with a dot in it for d, and so on. The letters are all made with straight lines and large open spaces. The dotted forms are of course not as good as the empty ones, and some of these are found in developed shape in our present alphabet, but others remain to be utilized if necessary.

sometimes perceived which failed of interpretation; for example, the answer y when r was the letter might be "y minified," or when o was guessed for d or b, "o magnified." Again, confusions of letters which in ordinary print extend, the one above, the other below the line, appear in the tables, but may be safely called impossible in actual reading. It might be questioned, too, whether tables made up for all degrees of distance and time show those confusions most to be feared under ordinary circumstances. But a collation of the errors made at the shortest distances and the longest times with those of Tables II and V shows a substantial agreement for most of the letters, and for most of the remainder the changes are only in the relative importance of the confusions. There is a tendency for unusual ones such as d for j and q, and g for r, to drop out; g shows a good deal of variation; a and s tend at the shorter distances to confuse a little more with each other than with other letters, but for longer times the reverse is the case if there is any difference; x is somewhat more likely to be called z or k, and less likely to be called n; and so with the other letters that show differences in order; but in the main, and especially for the letters most in need of correction, the table represents nearly enough the errors liable to occur in ordinary reading of letters like those tested.

The letters were chosen as being to a certain degree typical and furnishing a fair point of departure for investigating other letter forms, but generalizations from them must be made with caution. To settle finally and in detail just what letter form is to be selected as most legible would require a very long series of tests, in conditions as near as possible to those of normal reading, upon many existing and possible variations of each letter.

Physiological and Psychological Incidents.

The unusual conditions under which the eyes were used in these experiments brought to notice two or three optical phenomena, a description of which will help to explain some of the confusions found in the foregoing tables and may be interesting in itself.

At the longer of the distances used in the tests by distance, the letters appeared as dark grayish dots, and were recognized, if at all, chiefly by their outer configuration. These dots did not seem, however, to maintain one fixed and constant form; but on the contrary, while the subject strained his eyes to make one out, first one letter and then another would take form in it. This any one can try for himself by setting up a letter at a distance considerably greater than that at which it can ordinarily be read, and studying it intently. It would be extremely interesting to decide where the cause of this shifting and interchanging lies, whether in the apperceptive centres or in the retina. Every one knows the ease with which expectant attention perceives what it expects, and it may be that the variation in the letter dot is only a parallel and index of the movements of attention from one mental letter-image to another as they pass into the focus of memory. On the other hand, it might be in part at least a retinal matter. The average diameter of the cones in the fovea corresponds nearly to an arc of one minute in a spherical field of view; the square letters of the optotypes therefore, at a distance of 1.25 m., lay upon from twenty to twenty-five cones, and at the end of the rail on about four, and the other letters in proportion. Now if these retinal elements undergo more or less rhythmic changes (from fatigue and recuperation or from any other cause),

which are not entirely synchronous among themselves or with those of the other eye, it would give a basis at least upon which the attention could construct the changes of image described. The phenomenon is something like that of binocular rivalry, and like that, waits its final explanation.

In some of the time tests binocular effects were discoverable, but what there was to hinder exact convergence of the eyes it is hard to see. Such answers, however, as $ for t, 9 for b, ♀ for p or q, "a monogram of a and q" for q, "m with four strokes" for m, "two capital A's side by side" for A, show it beyond question, and no doubt some of the answers of w for v and of q for p should be attributed to the same cause. Such answers as the third and fourth would indicate that both eyes do not always see all parts of the letter with equal distinctness.

Another singular thing noticed when the letters were momentarily illuminated points the same way. A part of a letter would sometimes be seen normally solid and black, while the rest of it appeared faint almost to extinction; thus an h would have a solid body like an n, but a stem sketched in outline. In this way probably came the answers of o for q in both parts of Table V, and of n for h and v for y among the "old style" letters. Answers of this kind are to be found in Dr. Cattell's table of confusables in the *Studien*. They are so clear indeed that the conclusion seemed at first unavoidable that the narrow slip used by him had caused guesses to be made when only a part of the letter had really been visible at the instant when the attempt was made to see it. But this clearly cannot be the cause in the present instance. The phenomenon was not confined to the long letters, but cannot so

easily be shown from the table for the others. There hardly seems room here for a psychological explanation; but if for any reason one of the eyes received the whole h form and the other only so much of it as is like n, the different appearance of the stem and body of the letter would not seem strange. But this would require a different excitability of the retinal elements among themselves in one retina or the other, and in so far, if justified, would give a presumption in favor of at least a retinal factor in the variability of the letter-images before mentioned.

With the instantaneous illumination a curious illusion was brought out. As described above, the place of the letter was indicated by a small rectangle or triangle of pin holes showing as bright dots, and the letter itself was seen just behind a square hole in a black screen. When the letter was set accurately at the centre of the square it appeared, with reference to the dots, as it actually was; but when, as sometimes happened, the letter and its dots were turned too far or not far enough, so that the letter stood at one side of the hole in the screen, it was seen as displaced with reference to the dots also, and in the same direction as with the square. Attention to the illusion tended to destroy it, but otherwise it could be repeated almost at pleasure. It seems not to be of binocular origin; at least it has several times been obtained monocularly in a few tests made to try that point. The thing is difficult to account for, and no conjecture will be ventured at present.

It has already been said that unequal recollection of the letters of the alphabet has probably affected the tables given. The temporary dropping out of a letter has several times been noticed, and a few times its

return has been so sudden that the subject has exclaimed that he had been forgetting such and such a letter. The writer himself read d correctly a number of times at rates from 0.003s. to 0.005s., but at 0.006s. named it wrongly the three times it was shown, and only guessed it once in the whole set for any other letter. But a much more marked case was that of M, who, in thirty-five alphabets taken with the Snellen and "old style" letters at intervals from December 29 to the last of January, read c correctly but twice and made it but twice as a guess for some other letter, and during the same period never answered e at all; but on February 11, in three alphabets, taken to be sure with a little longer illumination, he read e correctly three times and guessed it twice for c. He showed no aversion to these letters in the distance experiment.

A certain hindrance to this dropping out of letters, at least for the distance tests, was interposed by the repetition of the whole alphabet; this is shown in the part of B's record omitted. The time being limited in which to take observations with decreasing distances, I thought to shorten the work by ceasing to present a letter as soon as it had been correctly read a certain number of times. At the distance 2.3 m. I omitted, without the knowledge of B, the letters f, g, m, q, r, w, and y. The omission of y had a strange effect on p, which I still continued to give. At 2.4 m. p was rightly named the three times it was shown, but from 2.3 m. to 1.9 m. it was constantly called y, and even at less distances did not escape confusion with that letter. That is to say, we have p, by right one of the clearest letters, mistaken for y, when z, t, n, u, and l were read and a, c, e, i, o, and s the only letters in doubt. The withdrawal of the corrective to the mental y-

form furnished by the actual y, and the dropping of p from the focus of memory, allowed the return of the y-confusion that had attended p at greater distances. The time covered by these experiments was about two hours. These facts make it appear that in the "letter habit" there is a variable factor which would have to be accurately determined before the law of probabilities could be applied to the letter-guessing tests for telepathy and the like.

The effect of practice is evident in the records for both distance and time. H was able to recognize all the letters with certainty at 1.5 m. when he began, and at 1.8 m. when he ended. M. was in doubt about c, e, and o at 1.5 m. when he began; on returning, the letters were brought no nearer than 1.9 m., where he recognized all the letters except c, j, o, and z; the errors for all but o being, however, but one each in seven or eight trials. B's record in general shows something of the same kind. The gain at this point measures the gain in distinguishing the worst letters; the better letters do not show so much, and a few were recognized on decreasing the distances only at a nearer point. The following averages of the distance for the eight alphabets from B's record on the letters from *Mind* show the gain for the alphabet as a whole: 0.935, 0.995, 1.076, 1.010, 1.090, 1.101, 1.240, 1.161. These were B's first trials with the letters. The first six were taken two a day on successive days, the last two after an interval of some weeks; the last is lowered somewhat through a loss of confidence. The table below gives the actual number of right and wrong answers and of the times when no answer was returned for the first twelve alphabets taken by the time method with J. H. The letters were the "old

style," including the five added letters; the time was 0.004s.

Right.	No Answer.	Wrong.	Right.	No Answer.	Wrong.
3	22	6	11	4	16
3	16	12	12	4	15
2	23	6	10	7	14
4	17	10	13	6	12
5	11	15	15	4	12
8	6	17	16	2	13

The first eight or nine alphabets taken on each subject were thrown out in making Tables IV and V by way of allowance for practice.

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p. 410. By an error of the draughtsman the ordinates of the curves for H are too short by four spaces and those of the curves for J by two. The curves in the lower diagram are those for B and M with the letters from *Mind*.

p. 418. The letters in the cut indicate parts as follows: *a* the pendulum, *b* the large cogwheel attached to it, *c* and *c′* the notched cardboard disks, *d* and *d′* the free brass disks clamping the last in place. In Fig. II *e* and *e′* are the two-and-a-half-inch gears, and *f* is the third disk which moves at the same angular rate as the pendulum. One of the mirrors is to be seen inclining forward above and behind the cardboard disks. Fig. I represents the machine ready for the fall of the pendulum.

WINTER ROOSTING COLONIES OF CROWS.

C. L. EDWARDS.

Crows constitute one of the most sagacious, gregarious, and omnivorous genera of birds. Throughout their wide distribution they form colonies which may be either small and of the family nature, where the crows do not migrate but live together throughout the year, or of large aggregations, composed mainly of migrants collecting together for the winter. In this country their winter colonies are found at or about 40° N. latitude along the Atlantic coast and in the valley of the Mississippi. They are so populous and so well organized, and their roosts so permanent, that they afford one of the best fields for the psychologist to study the manifestations of the social instinct. Although various phases of their gregarious habit have been recorded by a number of observers, there has hitherto been no systematic attempt to present the topic as a whole, including study of individual colonies, the number of colonies, with a general conspectus of the American literature and legislation upon the subject, such as is attempted in this preliminary report, to be followed by more detailed study of special phases later.

The importance of the topic for all interested in what, since Palmén and Beard, might almost be called the philosophy of bird migration, or in the study of those

remarkable social organizations our knowledge of which has been so well compiled by Espinas and which has been so suggestive to so many writers, or in the social organizations of mankind, is obvious.

Although throughout New England and New York crows are found as winter residents, and roosting colonies of several hundred individuals have been reported, yet the large majority of crows migrate southward to spend the winter. Audubon(3) says they "become gregarious immediately after the breeding season," forming large flocks which towards autumn remove to the Southern States. Dr. C. Hart Merriam tells me that in New York, soon after the nesting season, as early as July and August, the crows collect in flocks which gradually increase in size until numbering several hundred individuals. In October these flocks migrate, and with the crows indigenous to our more southern territory, form the winter colonies.

These colonies have been reported from Delaware, New Jersey, Virginia, Pennsylvania, and Maryland, in the East, and from near St. Louis, Missouri, Kansas, and Nebraska, in the West. Mr. Rhodes(6) gives a list of fourteen roosts: eight in New Jersey, two of which are now in use, the others having been deserted from two to forty-five years; four in the Delaware River, one of which, Reedy Island, is now in use, the others deserted from twenty to seventy years; and two in Pennsylvania, one of which is in use, the other deserted eight years.

The literature of crow roosts is not very extensive. The most historic is the Pea-patch, described by Wilson,(1) "near Newcastle, on an island in the Delaware . . . a low, flat alluvial spot of a few acres, elevated but little above high water mark and covered with a

thick growth of reeds. . . . It is entirely destitute of trees, the crows alighting and nestling among the reeds, which by these means are broken down and matted together." The colony was once destroyed during "a sudden and violent northeast storm" by the tide flooding the island. Wilson continues: "This disaster, however, seems long to have been repaired, for they now congregate on the Pea-patch in as immense multitudes as ever."

According to S. W. Rhodes[6] this historic roost, the condition of which Nuttall in 1829 did not know, "was abandoned soon after the construction of Ft. Delaware was begun in 1814, and . . . the crows betook themselves to Reedy Island as the most convenient substitute." Nuttall[2] first tells us of the colony at Reedy Island. Mr. George W. Jones, keeper of Reedy Island lighthouse, in a report kindly sent me by Dr. C. Hart Merriam, says: "The island, one mile from the mainland, opposite Port Penn, Del., is two miles long and contains about sixty-five acres of marsh land. There are no trees or bushes, but the reed grass grows very thickly upon the island. The crows occupy about twenty acres, breaking down the reeds, which are from seven to nine feet tall, and roosting upon the broken stems."

Dr. John D. Godman[4] has left some valuable observations upon the crow, and as he lived for a time in Anne Arundel County, Md., only three or four miles from the Arbutus roost (described later), it was no doubt the ancestors of these crows that he observed. "The roost is most commonly the densest pine thicket that can be found, generally at no great distance from some river, bay, or other sheet of water which is last to freeze or rarely is altogether frozen. To such a

roost the crows, which are during the daytime scattered over, perhaps, more than a hundred miles of circumference, wing their way every afternoon and arrive shortly after sunset." Mr. S. W. Rhodes[6] gives personal observations of a colony near Merchantville, Camden Co., N. J., which occupies oak trees twenty feet high, covering fifteen or twenty acres of ground.

Dr. Coues[7] says: "In settled parts of the country the crow tends to colonize, and some of its 'roosts' are of vast extent. Mine is on the Virginia side of the Potomac, near Washington." Concerning this roost a newspaper writer, "Invisible,"[11] tells us, among many highly colored items, that "for an unknown period of time, probably ever since the Potomac valley was settled, if not long before, the woods of 'Cooney,' the old ante-bellum popular term for that part of Alexandria and Fairfax counties bordering on the Potomac, have been occupied by a vast colony of crows. They now roost in the grand old oaks at Arlington. Years ago they occupied a strip of pines that grew back of the river above Georgetown."

Mr. H. W. Henshaw, of Washington, who has known of this roost for about sixteen years, tells me that the crows about Washington come in from the surrounding territory by three main streams, the largest coming from the south, down the river; the next in size from the east, flying over the city, and probably feeding along the shores of the Eastern Branch of the Potomac, and the third, scattering, from the west and southwest in Virginia. During cold or stormy days they do not disperse so widely and stay about on the Potomac flats near the city. Last year there were estimated to be 40,000 or 50,000, but this year probably twice as many. The main colony is of two or three bodies within the

area of a square mile. The roosts are not exactly continuous, but pretty close together, according to the clumps of trees. The fish crows are about one to five in proportion to the common crows.

In Baird, Brewer and Ridgeway[9] is an account of one of these colonies of crows, possibly journeying northward, "from the lips of the late John Cassin, an ornithologist hardly less remarkable for his outdoor observations than for his researches in the closet." On a Sunday morning in April, 1868, when Philadelphia was enveloped in an impenetrable fog, a body of crows numbering hundreds of thousands alighted in Independence Square. "As if aware of their close proximity to danger, the whole assembly was quiet, orderly, and silent. A few birds, evidently acting as leaders, moved noiselessly back and forth through their ranks, as if giving tacit signals." Then scouts departed to explore, and upon their return the leaders again went cautiously through the ranks. But they did not move until another exploring party had made its report, apparently more favorable, then "the whole of this immense congregation rose slowly and silently, preceded by their scouts, and moving off in a westerly direction, were soon lost to view."

The fish crow (*C. ossifragus, Wils.*) is confined to the Atlantic seaboard from Long Island to Florida, and the common crow (*C. americanus, Aud.*) is most numerous east of the Rocky Mountains. W. W. Cooke and Otto Widemann[8] say that the common crow is a resident of St. Louis and vicinity, roosting by thousands in winter among the willows opposite St. Louis.

In a note in the *American Naturalist* for December, 1887, Mr. W. Edgar Taylor[10] signalizes a roost "covering perhaps four or five acres, on Hog-thief Island, in

the Missouri River, about six miles above Peru, Neb." "Two other good sized roosts are known, one ten miles north, and the other on an island eight miles south of Hog-thief Island." Mr. N. S. Goss, author of "Kansas Birds," is quoted as saying that several large roosts exist in Kansas.

Mr. Taylor says the Hog-thief Island roost has been occupied for at least twenty-five years. "The crows assemble about the first of October and disperse about the first of May. About daybreak on a fine morning, when setting out for a day's journey, their chatter and noise may be distinctly heard in Peru, six miles away. The crows in severe winters peck holes in the backs of hogs, in some cases eating off the ears. Sometimes these crows roost in small bushes and large weeds, but generally in trees, often the willow or cottonwood."

In the great region west of the Rocky Mountains we practically leave the haunts of those species of the crow genus heretofore considered, and enter the land of the largest of crows, the American raven (*C. corax sinuatus*, *Wagl.*). It is interesting to learn from Baird, Brewer and Ridgeway[9] that the ravens form winter colonies much as our eastern species. Dr. Coues is quoted as observing them "congregating in autumn and winter, about Fort Whipple, Arizona." Their roost was in the pines near the small enclosure where the beeves were slaughtered for the garrison, "and the banqueting there was never ended" upon the offal. Also Captain Blakiston observed them near Fort Carlton. They keep together in pairs during the day, but at night roost in one immense body in a clump of aspen trees about a mile from the fort. The incoming and outgoing of the ravens from the roost was with wonderful regularity. They assemble about sunset and disperse about half an hour before sunrise.

Mr. Watase (a Japanese student in this University) tells me that there are vast numbers of crows in Japan, especially in the northern part, where they do immense damage to the crops. In Tokio, in the great forest called the Emperor's Garden, right in the heart of the city there is a colony of many thousand crows which have their nests there, and at dusk from ten miles about they gather at this rookery. Some ten or fifteen years ago a law was passed in Japan that the crows be exterminated. All their nests were torn from the trees and policemen were dispatched in every direction to kill them. Thousands had been destroyed when some thoughtful person suggested that the crows were of great value to the city as scavengers, then the carnage was ordered to be stopped, and to-day, protected by law, they are apparently as numerous as ever. But where the crops suffer from crow depredations, as in the north of the empire, the law giving a bounty of five cents for every crow's head is still in force, and there are men who do nothing but go about killing crows, and indeed make of it a lucrative business. The crows sometimes become so violent that they attack the trains of pack mules which carry fish inland from the seashore. They pick off the flesh from the mules' backs, pluck out their eyes, and at times become very dangerous and violent, so that it is with great difficulty that they are driven off. There are three species in Japan, *Corvus japonicus*, which is distinctly Japanese; *Corvus corax*, which is said to be identical with our own raven; and *Corvus corone*, the common crow of Europe.

The colonies, which are formed only for the winter, come together late in the fall and break up in the spring, following the generally accepted laws of bird migration. In the report of Mr. Jones, of Reedy

Island, in part given above, he says that the crows come from the first of September until it gets cold, and begin to leave by the first of April, until in the last of May none are left. While at St. Louis, Cooke and Widemann[8] say that by March 14th most of the crows have left the winter roost.

The main element bringing them together in a common body at night, I take it, is the social. In the choice of a roost, scarcity of mankind and access to food, combined with a growth of trees available for roosting upon, are the principal points considered. A region once selected is kept for a great many years, if there is no very decided disturbance to cause emigration.

In the following study of the colonies at Arbutus and Avondale, Md., I have attempted to describe the life of the colony during the twenty-four hours of day and night. The facts given are from observations made by the writer during the winters of 1886–87 and 1887–88.

A.—The Arbutus Roost.

Seven miles southwest from Baltimore, a half mile southeast of Arbutus station on the Baltimore and Potomac Railway, is a tract of land of about a half mile square on which are several patches of woods which furnish the roosting ground and its neighborhood for a winter colony of crows. It seems from the testimony of the owners of this land that the crows have roosted there for about twelve years, having previously occupied a piece of woods a half mile or more to the westward, which they abandoned when house-building and wood-cutting by the inhabitants made it undesirable. Although this ground has been for some years the headquarters of the colony, yet it has during that time made temporary changes to

places within a radius of one or two miles. Within this more extended limit, in the memory of "the oldest inhabitant," which individual has lived near Arbutus for over half a century, the crows have come to make their winter colony.

Dr. Godman[4] says "such roosts are known to be thus occupied for years, beyond the memory of individuals; and I know of one or two which the oldest residents in the quarter state to have been known to their grandfathers, and probably had been resorted to by the crows during several ages previous."

There is in the first mentioned half-mile tract one particular piece of woods containing about fifteen acres of ground which seems to be the favorite roosting place of the crows, and from which, according as their numbers increase, they overflow into the surrounding woods and bushes. The trees are mostly of black oak, with some chestnut, white oak, poplar and other common forest species, all of a decidedly "scrubby" growth, not being on an average more than 25 or 30 feet high. The woods are situated in a sort of valley quite surrounded with hills which have been cut into jagged, fantastic forms in the several centuries of digging by the inhabitants for the rather poor iron ore of the region. The dumping of the refuse from these excavations in the hollow or valley has caused huge mounds here and there, and these, together with the well eroded slopes of the small hills, give a decidedly picturesque outlook to the arid land.

The country being of poor soil is sparsely settled, and a glance at a map on which all of the houses are indicated shows in a striking manner that this roost is in a region where are fewer houses than for miles around it. So these persecuted birds over whose heads

the Maryland statutes of outlawry have been hanging for almost two hundred years, would be stupid indeed if they had not learned to avoid man and his gun on every possible occasion, and to seek the most secluded spot available for a roosting place.

The neighboring farmers, with unusual good sense, seem to appreciate the value of the crows, rarely disturbing them, and how far the colony understands this I will of course not attempt to say.

On a bright sunshiny day, up to within about two and one-half or three hours of sundown, the only crows discoverable are the few which remain to feed in this territory, as their allotted ground, when the colony at dawn breaks up for the day. Perhaps in addition some that are blind or sick, too weak to fly far away, have remained at the roost. On a foggy or snowy day, however, more linger about all day, the main body is considerably delayed in dispersion, and the crows come in earlier in the evening. Now, by about three hours before sunset on a clear day, evidently having secured their daily rations, these few fly to above one of the several gathering grounds of the large flocks or detachments of the main body of crows which are to come later. In the course of an hour the few already in are joined by one now and then until quite a number have come together, screaming out their *caws* vociferously and discordantly. This small flock may perchance fly over into the woods a mile to the westward, and by the time it returns in the course of fifteen or twenty minutes will have grown to a very large flock. As it settles down on a near corn field with much fluttering of wings and very successful attempts at making a great noise, its individuals nervously hopping or flying from one spot to

another, one is reminded of a flock of overgrown black birds at the migrating season foraging in some stubble field for food. Suddenly from some common impulse the flock rises and moves away on an excursion for perhaps three or four miles. As the crows rise and start away their noise is, if possible, increased, but gradually dies out as they approach the distant hill, and is quite lost before they disappear to sight on its further slope. When they are gone the wintry field which for an hour has been associated with the noisy birds seems quite desolate.

But now as the sun is becoming large over the western hills we see in almost every direction, singly, in pairs, in small groups, the crows centering toward the roosting ground, and by the time the flock we first observed returns from its excursion it has become decidedly reinforced. Before settling down the flock may again wander off for two miles or more, but so many new individuals are arriving that a number do not join the main body, but seek the tops of the black oaks as if settling for the night. It is about sunset when these first ones alight, and it is not long before twenty or thirty of the nearest trees on the edge of the woods will each have seven or eight black figures perched upon its topmost branches.

Just as the sun is sinking below the horizon the flock which wandered away returns, and so many more crows have joined the force that it has grown to immense proportions. The sunset appears to be the signal for all crows, individually or in flocks, to centre at the roost. They come then in long streams, irregular in outlines perhaps, but rather constant in numbers, and after sunset the incoming is almost without noise, save the sharp whirring of their wings.

Audubon[3] says: "They may be seen proceeding to such places more than an hour before sunset, in long straggling lines and in silence, and are joined by the grackles, starlings and reed birds, while the fish crows retire from the very same parts to the interior of the woods, many miles distant from any shores."

Also Dr. Godman[4] observes that "endless columns pour in from various quarters, and as they arrive pitch upon their accustomed perches, crowding closely together for the benefit of the warmth and the shelter afforded by the thick foliage of the pine. The trees are literally bent by their weight, and the ground is covered for many feet (?) in depth by their dung, which, by its gradual fermentation, must also tend to increase the warmth of the roost."

But among those which have settled upon the perches there is a good deal of *cawing*, which may serve to guide to the roost their fellows belated in the dark or storm. At times, if unusually disturbed, instead of remaining upon the trees they will fly back and forth and high into the air, making considerable noise. Those coming in sometimes answer this signaling, especially if, as I witnessed in the case of a heavy snowstorm in December '87, they may have cause to be confused. As they appear suddenly from out of the distant darkness, or from the thickest of the swirling snow, a spectre procession without beginning and without end, one is haunted by the weird reality of the ghostly scene. We seem to be looking at Poe's "Raven" and all its earthly relations, coming as mysteriously as did that uncanny guest, in a series that shall end "nevermore!"

This body, however, is but one branch of what we must now compare to a vast army of crows. And as

this division is marshaled into camp, from at least two other directions great bodies are coming in streams, settling down upon the trees or flying high above them, outlined against the red after-glow of the sun. The air, as far as one can see toward the west, seems literally alive with crows. It is as if one of those huge swarms of gnats which we are all familiar with in the summer sunshine had been magnified until each individual gnat was as large as a crow, without any diminution in the total number of individuals.

In the winter of '86–'87, as one of a party from Baltimore, I saw one of these vast divisions coming in for the night with singular regularity. It came from the northeast, and as it approached our point of observation was somewhat hidden by a clump of trees, until within a hundred yards of us the procession made a sharp bend and the crows were directly over the woods which constituted the roost. If you will imagine a river one hundred and fifty feet wide and about thirty feet deep, its end a huge cataract by which the water falls to lose itself in a large lake, its beginning farther away than the eye can see, and if instead of water you will make this river of crows not so closely packed but that they can fly easily, and make the swiftness of the current equal to the ordinary flight of the crow, you may gain some idea of the stream which our party watched for over an hour without noticing any diminution in its bulk. And what a lake it made! When a gun was fired the crows rose above the woods like a great black cloud, and when they settled again every available branch of the thousands of trees was utilized to afford them resting places.

Mr. Rhodes[6] says: "The aerial evolutions of this descending multitude, coupled with the surging clamor

of those which have already settled as successive reinforcements appear, and which at a distance greatly resembles the far-away roar of the sea, may justly awaken emotions of sublimity in the spectator."

The crow is ever a wary bird, and even after having perched for the night is easily disturbed. If one walks through the woods where the crows are roosting, the nearest ones rise with the *caw* of alarm and fly over the trees to the farther edge of the main body. If one walks steadily toward them they keep as steadily giving way in orderly wave-like retreat. I have thus followed this colony from copse to copse through the whole neighborhood of its roost. If while walking one but stops, with no other movement, the crows immediately suspicion some treachery and there is a noisy stampede of all within danger. Very probably they have learned that a gunner always halts when about to shoot.

On the morning of February 19th I saw the colony disperse for the day under peculiarly favorable circumstances. The sky was perfectly clear and well lighted by the stars and the moon in its first quarter. We reached the field within 100 yards of the roost about half-past three o'clock in the morning. Because of some noise in walking over the frozen furrows, a few of the nearest crows took alarm at our approach and flew back a few rods into the woods; but this without the slightest noise, save the cracking of some branches or the whirring of their wings in the retreat. For over two hours all at the roost was silent as a graveyard, except that every now and then some restless individual, a sentinel perhaps, would utter a most peculiar croak, just like the louder note of a bull-frog.

But just an hour before sunrise, when the east was

becoming faintly lighted, the crows suddenly commenced awakening, and at the same time commenced cawing. The few who led the measure were within one or two minutes joined by the full chorus of 300,000 or more voices, each apparently striving to be heard by all the rest. Never before had I realized the almost infinite possibility of the crow's variable *caw* in the production of discords. This great noise, which the poetic soul of Audubon conceived to be "*thanksgiving*" and "*consultation*," was kept up for twenty minutes before any movement was discernible. Then about a dozen crows started off for the day's work, followed by more and more, until they were going from the roost much as they return to it in the evening, in the three or more large streams. The crows, however, were much more scattered in the order of flying than in the evening streams. After they had been leaving thus for about twenty minutes, the streams constantly growing larger, a common impulse seemed to move a large number of crows, and they did not wait to "fall in" as individuals, but suddenly joined the stream as a large flock. The streams were thus swollen in bulk quite regularly about every five minutes until the colony had dispersed. In an hour's time, or just at sunrise, the whole body, with the exception of twenty or thirty, evidently too weak to go far off, had left the roost. All this time the din of the general body does not seem to diminish, those left behind apparently doing double duty in the *thanksgiving*, while those going away, as far as one can hear, do not fail to keep up their cawing. In this respect they differ from the evening streams, which in the main come in with but little if any noise. In seeing this morning dispersion I think one is impressed even more than in

the evening with the vast number of crows constituting the colony.

In the daytime the individuals are scattered all over the surrounding country, seeking food in the fields, along the shores of bay, river and creek, one and two together, and then in rather large flocks at the glue factories and stock-yards if there chance to be such rich grounds in the neighborhood. They disperse to a radius of from one to about forty miles over the fields and along the water courses. I have seen them scattered all the way from Baltimore to Philadelphia on the one side and to Washington on the other. Of course these crows were members of two or more colonies.

Mr. Rhodes(6) says that "during winter a radial sweep of one hundred miles, described from the city of Philadelphia and touching the cities of New York, Harrisburg, and Baltimore, will include in the daytime, in its western semicircle, fully two thirds of the crows (*C. americanus*) inhabiting North America, and *at night* an equal proportion in its eastern half." Mr. Rhodes was evidently not familiar with the fact of large numbers of crows wintering in the far South and the West.

That they fly from very long distances is shown by the fact that there are usually a few individuals coming in with the main body who, upon reaching the roosting ground, are so exhausted as to be unable to fly, and can only hop about as best they may to escape their ground enemies. Upon Dec. 17, 1887, were caught two of these crows which, if I may so express it, had the *flyer's cramp*, for in every other respect they were apparently in good condition and are now in sound health. That the muscles of flight had suffered a partial paralysis is shown by the fact that in the

course of a week they had so much recovered that had not their wings been clipped they would probably have flown away.

The successive layers of autumn leaves and excrementa left by the crows in winter have formed a remarkably rich compost for the naturally rather poor soil. Upon a field formerly a part of the woodland which formed this roost, but from which the trees were cut three years ago, much larger crops have been produced than from neighboring fields. Upon this ground many plants new to this part of the country, such as "river weeds," have been noticed by the farmers. In some of the excrements from this roost sent to Dr. Merriam were identified the seeds of the sumach (*Rhus glabra*) and corn, but the seeds of a species of plant much more numerous than either of these could not be identified. Among the small stones, bits of brick and sand and broken shells were found fragments of *Modiola hamatus* and *Arvicola riparius*. Thus it is evident what an important part the crows play in plant, and possibly animal distribution.

In this colony I have identified both the common crow (*Corvus americanus, Aud.*) and the Fish Crow (*Corvus ossifragus, Wils.*). The two species live together very contentedly, although probably in the main seeking different feeding grounds. I believe the common crows are much the more numerous of the two; but on the wing they are scarcely distinguishable, except by voice, and so the exact proportion of the two kinds is virtually unattainable.

It is an interesting although rather discouraging operation to attempt to separate the variously intoned caws and imagine the condition of mind each one represents. It is a veritable Babel! Old crows, with

a voice like the rasp of a file as it plays on the edge of a saw; middle-aged crows, with long-drawn caws that have andante movements about them, destined to linger in one's ears after the musical apparatus has vanished from sight; and young crows, just learning the difficult art of expressing their emotions, who get along excellently until all of a sudden their note terminates in something totally unexpected, like a boy at the adolescent age, when he is never certain whether he will talk falsetto or base. But in all these different shades of tone there is that one unmistakable nasal basis which so clearly distinguishes the crow's caw from all other bird notes.

C. C. Abbott(5) says: "Crows have twenty-seven distinct cries, calls, or utterances, each readily distinguishable from the other, and each having an unmistakable connection with a certain class of actions; some of which, as for instance the many different notes of the brooding birds, are only heard at certain seasons." Though we may not agree with such an exact classification, yet it is undoubtedly true that crows express quite different states of mind by quite different notes.

A determination of the exact number of crows here collected is not possible, but even the most sober observers place it among the hundreds of thousands. As a basis for an approximate calculation, I have made the following observations at the roost. With the aid of two friends, fifteen different square rods, taken here and there at random, were paced off, and the number of trees thereon capable of furnishing roosting tops counted. An average gave us nine and three-fifths trees per square rod. At any one roosting the crows occupy about ten acres, or ($160 \times 9\frac{3}{5} \times 10$) 15,360 trees. If on each tree fifteen crows roosted—and that, if anything, is not too

large an average—we should have 230,400 crows in the colony.[1] Because of the dim light at sunset, my attempts at taking instantaneous photographs of the incoming streams of crows were failures. A view, however, of one of the gathering flocks, taken about an hour before sunset, as it flew by in a straggling stream, shows two hundred and seventy-three crows in the photographic field. On this basis, the flying time (an average of a number of observations) for the bird to cross the field being fifteen seconds, in three streams coming in for one hour we should have 199,560 crows. But the streams toward the middle and end of the incoming are manifestly much larger than the above, so this number may be taken as a minimum estimate.

Dr. Godman[(4)] says: "During hard winters many crows perish, and when starved severely, the poor wretches will swallow bits of leather, rope, rags, in short anything that appears to promise the slightest relief." I have often found crows sick of various disorders which I shall not attempt to classify, going blind and starving, and in the aggregate for a winter many suffer the inevitable fate of mortals. I have found as many as eleven sick and recently dead crows upon the roosting ground in one day, and no doubt the hawks and opossums have found as many, for they are so boldly fond of the birds as to become noticeably increased in numbers in the region of the roost in winter, and of their visits well picked bones scattered about bear testimony. But the consumers of crows are not confined to hawks and opossums, for there is an

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[1] It is difficult to realize the meaning of such a large number, and perhaps an illustration may help us. It happens that if one crow came in each second, day and night, it would require just 64 hours for this number to assemble.

old colored man in the neighborhood who eats the fresh birds, and when his larder is abundantly supplied, salts down the crows for future use.

Having the total population of the colony and the average death rate we may calculate the average age of the crow. I think that a death rate of five for each night at the roost, drawn as an average from a number of observations, is certainly not too low. Allowing that during the almost equal period the colony is away from the roost the same number die, we then have a daily death rate of ten, or a yearly mortality of 3650 crows. So a colony of 230,400 individuals would be a fraction under 80 years in dying off; or in other words, the potential longevity of the crow would equal about 80 years. It is well known,[1] at least traditionally, that the crow is of remarkably long life, and although, as is easily seen, there are many obstacles in the way of anything but the barest approximation, yet I believe the above calculation is founded upon factors approximately correct.

Through the kindness of Dr. Pattison, of Baltimore, I have been made aware of a roost near Avondale, Carroll County, Md. I visited this colony March 3d, spending half a day at the roost and in the immediate vicinity. The crows here have selected the slope of a high hill upon which is a thick growth of deciduous trees, the oak and the chestnut prevailing. This hill

[1] "This bird sometimes lives for a century or more. Those have been seen in several cities of France which have attained this age, and in all countries and in all times it has passed as very long-lived."—Buffon, *Histoire Naturelle*, Tom. XVIII, 1775, p. 32.

"The raven likewise is reported to live long, sometimes to a hundred years. . . . But the crow, like unto him in most things (except in greatness and voice), lives not altogether so long, and yet is reckoned amongst long livers."—Bacon, quoted in Essay on *Comparative Longevity in Man and the Lower Animals*, Lankester, London, 1870, p. 67.

belongs to a range extending some fifteen or twenty miles from northeast to southwest, parallel to the mountains which, some twenty-five miles away, can be seen from its crest. The exposure of the slope is toward the south, and so the crows in adopting this site are quite protected from the cold northern winds which prevail in winter. There are large tracts of woods adjoining this roost, but only when driven away by shooting do the crows leave this favorite hillside. They have roosted here for about ten years.

The general life of this colony is much as at the Arbutus roost, and I should judge the two colonies to be of about the same size.

Crow Legislation.

The legislation upon crows in Maryland has been quite extensive, the first law for their destruction having been framed in 1704, in connection with one for the destruction of wolves. A part of the section relating to crows is as follows: ". . . Every person that shall bring or cause to be brought to any of the Justices of the peace in any county within this province the head of a Crow with a perfect Bill shall be allowed the sum of six pounds of Tobacco and the Justice of the peace before whom such Crows heads shall be brought shall cause the Bill to be cutt off to prevent the deceit of twice or oftener paying therefore." This law, in 1707, was continued for three years, then revived in 1710. In 1713 a new act was passed putting the squirrels also upon the list of outlawry. This act was continued in force by supplementary acts in 1716 and 1722. In 1728 a new general "act to encourage the destroying of wolves, crows and squirrels" was passed. In it we find that "every

master, mistress, owner of a family, or single taxable, in the several and respective counties within this province" shall be obliged to produce "three squirrel scalps or crows heads for every taxable person they pay levy for that year." The penalty of not producing the required number of scalps or heads was two pounds of tobacco for each one lacking, and for any in excess a like allowance was made. This law was in force for thirty years, when it was repealed, and an act specifying four squirrel scalps or crows' heads was substituted.

Special laws for redeeming heads or scalps in excess of the requirements of these general laws were passed for different and various counties of the State, in 1749, '62 (Baltimore Co.), '94, '95, '96, '98, 1803, '04, '07, '09 and '16. In 1824 all acts heretofore passed for the destruction of crows in the several counties of this State were repealed. Then new special laws were passed in 1826, '29, '30, '31, '46 and '47. In 1860, with the adoption of the first general code of laws for Maryland, Art. 31, concerning crows, was inserted. In it was specified a bounty of 6¼ cents for each crow's head brought in, provided an oath was taken that the crow had been killed in the county where claim was made. In 1864, '78, '80 and '84 (Baltimore Co.), the law was repealed for certain counties. In 1882, '84 and '86 new special laws associating with the crows "hawks and big owls" have been passed.

I have consulted the general statutes now in force of all the States, and find only in one other State, Virginia, that a law concerning the destruction of crows is extant. As early as 1796 a law was there passed requiring for every tithable six crows' heads or squirrels' scalps. In the Code of Virginia for 1873 the right is

given to each county to "allow or discontinue rewards for killing in such counties panthers, wolves, foxes, wild cats, crows or blackbirds."

I have read statements of laws having been passed in the early days of New England, and of such large numbers of crows having been destroyed in one season that, the crops for the next season suffering a like fate from the cut-worms and other insects, the inhabitants by repealing the laws were glad enough to encourage the crows to come back.

The general effect of these laws has been to cause the destruction of large numbers of crows. Dr. Godman[4] has with graphic pen described the methods of hunting and slaughtering them in Maryland in the first years of this century.

It is interesting to learn from Mr. Henshaw that such near relatives of the crow, the blackbirds (*Argelaius gubernator*, *Wagl.*, and *A. phoeniceus*, *Linn.*) at San Luis Obispo collect in the fall and winter in immense flocks and roost in the swamps of tulle (a kind of bulrush). They do not come in to the swamp in streams, but in large flocks, and these diving down into the reeds are very soon hidden.

This dwelling together in large flocks is also quite true of the crow blackbird or purple grackle (*Quiscalus quiscula*, *Linn.*), as we see in this latitude after the breeding season and until migration, and in the South during the winter.

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PARANOIA.

A Study of the Evolution of Systematized Delusions of Grandeur.

From the Clinical Records of Bloomingdale Asylum, New York.

BY WILLIAM NOYES, M. D.

The following case[1] presents several features of especial interest to the student of systematized delusional insanity. The slow beginning, the gradually increasing systematization, and the evolution of a special talent into the most prominent feature of a chronic primary insanity, developing in a constitution showing original unstable mental equilibrium, make it a typical case of Paranoia.

Mr. G., 42 years of age, has been an inmate of the Bloomingdale Asylum since April 30, 1884. He was

[1] This article, under its present title, was prepared for the press and in the hands of the editor of this Journal in March, 1887, but a combination of circumstances has prevented its earlier appearance. At the same time the writer made a translation of an article by Dr. Séglas on *Paranoia*, giving an historical and critical review of the study of mental degenerations and systematized delusions, with a complete bibliography of the literature of systematized insanity. This statement is made here to explain the abruptness with which the discussion on classification at the end of this paper closes, it having been hoped that this article and the translation would appear in the same journal, thus making a continuous contribution to the study of systematized insanity, but this has not been found practicable. Those interested in the discussion of *Paranoia*—a term to which Dr. Spitzka has given the weight of his authority in the edition of his Manual of Insanity in the autumn of 1887—are referred to the article *Paranoia* in the *Journal of Nervous and Mental Disease* for March (*et seq.*), 1888.


LUNA·

born in a New England city, of American parents, and his childhood and youth were passed without any special sickness or disease save those common to those periods of life. As a child he showed an unusual fondness for drawing, which was noticed very early by a lady friend of the family of some artistic ability, and she fostered and encouraged his natural inclinations by furnishing him with drawing materials and showing interest in his progress.

He attended the public schools of the city and was considered unusually bright, gaining special distinction in elocution. At 16 he entered the dry-goods business in the capacity of clerk, but became discontented, and after three years came to New York and studied art. For several years he did work for the illustrated weeklies, making comic sketches, illustrating current events, doing lithographic work, and employing himself in similar work without gaining any special advancement. In 1874 he went to Paris and studied art under Gerome, remaining there eight years. His life there was full of vicissitudes, and presented sudden changes from luxurious living to dire poverty. Owing to his bright and witty manners he was much sought after by wealthy young men, and while entertained by them he lived in much luxury, but after their departure he was obliged to exercise the most rigid economy, living, as his father expressed it, "on a herring and cracker a day." His life was also very dissipated as well as subject to hardship and privation. In one of his periods of excess he had an attack of *mania a potu* in which he cut his throat and his left arm. He bled freely and his escape from death was narrow. From that time he has been a total abstainer. An interesting companion, a quick

and ready talker, an excellent story-teller, with flashes of wit and sharp repartee, he presents a typical example of the artistic temperament with its ready susceptibilities, its quick sympathies, and its appreciation of the beautiful. Yet it is the mere sensuous part of the artistic nature that has been cultivated, and no firm purpose or high ideal appears to have governed him; and his whole life has been one of fitful changes and impotent strivings, ending in failure. A good singer and amateur actor, he frequently took part in private theatricals, and at one time thought of going on the stage, and even played a few weeks with a professional company.

He returned to America from Paris and began work again as an illustrator of books and magazines. He opened a studio in this city and gave promise of a brilliant career; but soon after his return his friends noticed a change in his disposition, in a general exaltation of mind and a reckless expenditure of his limited means for odd bits of furniture, swords, and bric-a-brac for the decoration of his studio. Everything that was odd struck his fancy, and he soon came to possess a rich collection of curios. The exaltation increased, and in the summer of 1883 he was troubled with insomnia that continued for several months, but the first positive evidence of mental disturbance came in November, when he began giving away his costly treasures and breaking up his articles of furniture, saying that he had no further use for them. He also shaved his head and mutilated his body as acts of penance. For ten weeks there was a remission, but at no time was he in his normal condition. On the day before his admission to the asylum he was boisterous and ordered the train to be stopped and asked every

one to take a drink. On admission he professed not to remember these actions. The next morning he was elated and demonstrative; said, "It is a fine day, thank God," and on passing through a door, turned around "so as to be on the right side with God." He admitted at one time several weeks later that his actions had been eccentric, but later denied this, and said that he had never been out of his mind, and the world would soon see the great work he was to do. By the end of June he had ceased to "thank God" at the end of every sentence, but stated that he still thought it. A day or two later he became stupid and morose, and being asked the reason, replied "God knows," and would not answer any questions. The second day he became violent, and through the night was noisy at intervals, shouting and jumping up and down in his bed. The third day he talked excitedly and made frequent use of the expression "thank God." From this point this attack gradually subsided. Before the attack he had been reading his Bible diligently, and in a few days he resumed this practice and became silent and absorbed, reading his own thoughts, as he explained later.

Through the summer he remained quiet and was unwilling to converse with his friends, but this condition changed in October, when he showed a desire to converse on religious subjects, and told the supervisor that he expected by constant study to understand every word in the Bible, and that although he had been told that this was an impossibility without a thorough knowledge of the Greek and Hebrew languages, yet by faith and study he hoped to attain the desired result.

He was usually very reticent and would only inti-

mate that he expected to receive some supernatural endowment; stated that he believed the miracles of the Bible and that miracles were performed at the present day.

Early in December, or about a year from the first appearance of his trouble, another period of exaltation came on; he laughed at pathetic passages in plays; quoted from Shakespeare and the Bible, to the annoyance of his fellow patients; spoke roughly to the attendants; joined in the religious exercises at chapel with more than his accustomed fervor; and used the expression "thank God" the same as on admission; and confessed that he could not resist the impulse to sing and shout. At this time there was marked tremor of the facial muscles and his left pupil was larger than the right. He talked in a loud and declamatory manner and showed some personal violence. After two days this attack began to subside, when he said he had been perfectly well, and spoke much of the love of God and his trust that everything would be made clear to the people here some day. This attack was again followed by a period of depression in which he secluded himself, was unwilling to take exercise, and was wakeful at night; and at one time was heard to say that he wished for some one to kill. A period of mild exhilaration followed, in which he spoke much of the beauty of the world being due to the goodness of God, and became annoying by his frequent quotations. His actions became more and more eccentric at this time, but were all due to a consistent following out of his systematized delusions on religious subjects. He would never wear rubbers, giving as a reason that he had never done so, but it is almost certain that his true reason was that he had no right to protect himself from any weather God sends; stormy weather is

part of the divine plan and we ought to submit to it without murmuring. For the same reason he is unwilling to wear gloves even in the coldest weather, saying that his faith keeps him warm and free from disease. If allowed to do so he would keep his window open to its fullest extent even during the coldest weather, because the pure air of heaven is from God, and man therefore cannot be harmed by it. An arrangement of his window so that he can open it but a few inches he looks on as tyranny and a gross abuse of power, but he submits because it is part of his discipline. Early in January, 1885, delusions of persecution developed for the first time, and he complained that some one entered his room at night, and he concealed a billiard cue to attack his supposed visitor. This was accompanied with mental disturbance, and he became declamatory and talked of "God's bright sunlight," to the annoyance of others. About this same time he began to mix dried geranium leaves with his tobacco, so that "by the grace of God he might be benefited by them." He reproached the house-steward for shooting cats, and told him to put a note in the basement where the cats would see it stating that the cats were no longer wanted here, and "if he only had faith of the right sort the cats would no longer trouble him." Soon after this he one day removed a considerable portion of his clothing, tied a red handkerchief about his head and began stamping up and down his room. Being asked the meaning of this conduct, he shouted, "Go and read the second chapter of Genesis and you will see what the Lord says." Bearing in mind his later ideas of the progress of the Holy Spirit from Adam up to Christ, it seems probable that at this time he began his spiritual pilgrimage from the garden of Eden through the various prophets until he shall

finally reach and become part of the Deity. For the next few days he remained constantly in his room, reading his Bible and making grotesque motions or gestures before it in the hope that it might be revealed to him. A month later he stated, in reply to questions, that he considered himself a martyr and most unjustly confined; that he was perfectly well in spite of his queer actions, singing and talking; that he had been slandered, and expected to go down to his grave a persecuted being. He now began picking up bits of string, stones, tinfoil, tobacco, tallow candles, leaves and dirt, jumbling them all together in his pocket. They did not appear to be collected from the mere love of hoarding a mass of trifles, so often shown by the insane, but were saved because everything is of value in this world and nothing should be thrown away, for to pass such things by shows a neglect of God's good gifts to man. To remove these and to take his Bible and fantastic decorations away was to persecute him, but he would not complain and would bear it in silence as it was part of his discipline. Throughout all these gradual changes and evolutions of his fancies into systematized delusions the artistic element always predominated. Burnt matches, pine cones, sticks and stones, were all arranged with his gay-colored handkerchief into odd fantastic shapes that immediately struck the eye on entering his room. In the autumn of 1885 there was a return of his delusions of persecution, and he said that one of the attendants had put an evil eye on him, and that he had seen his physician's eye change from blue to brown. During the succeeding winter he was inclined to expose himself to cold more than ever, and if permitted to do so would stand without clothes in his room on the coldest nights with windows raised to show that his faith kept him warm,

and in the morning would break the ice in his pitcher and take a cold bath.

Regarding man's spiritual nature he said that each person is being continually worked on by different spirits which the normal man is able to hold in check and prevent from getting the upper hand, but when the spirits once get the control, then the individual is completely dominated by them and loses his personality. People complain of heaviness of the head because, as they say, one hemisphere of the brain is not in good condition, but this is all nonsense, for the two hemispheres represent the male and female parts of the individual, and when the head aches there is discord in the household, as in the ordinary troubles between man and wife.

In the summer of 1886 he began a drawing that should illustrate the evolution of the Holy Spirit through the various Biblical personages, beginning with Adam and ending with Christ. This and five others that he drew with slight variation, appear to represent the complete systematization of his delusions and the complete theology that he has evolved through his years of study of the Bible. Mythology is mingled in with the theology, but to his mind it is an integral part of the whole and cannot be separated. His description of the diagram is here given, written in red ink in the original as typifying the redeeming blood of the Saviour.

Arcana Vitae.

Baptisms.	*Seals.*	*Crosses.*	*Churches of Asia.*
Cain	Germ	St. Andrew	Ephesus
Flood	Zodiac	St. Colomba	Smyrna
Sodoma	Tribes	St. George	Pergamos
Abram	Aceldama	St. Michael	Thyatira
David	Holy Stones	The Prophet	Sardis
Babylon	Prophet	St. Evangeli	Philadelphia
Christ	Sun	Royal Priesthood	Laodicea

EZEKIEL'S VISION BY THE RIVER CHEBOR.

Male			Female	
Right			Left	
Man	Lion		Ox	Eagle
Thought	Might	Cherub	Endurance	Emulation
Abr. to Dav.	Dav. to Bab.		Bab. to X	X to Present

So all the generations from Abraham to David are fourteen generations; and from David until the carrying away into Babylon are fourteen generations; and from the carrying away into Babylon unto Christ are fourteen generations.—St. Matthew 1st, 17th.

PROGRESS OF THE HOLY SPIRIT OF THE CHRIST AS PREFIGURED IN THE OLD TESTAMENT.

Seal of the Germ.—From Adam until the Flood the Holy Seed was sifted through man's nature until it was concentrated in the family of Noah. That which was thoroughly beastly perishing in the Flood. This period marks the first Sealing of the Soul or first step towards the mystical body of Christ.

Seal of the Zodiac.—From the time of Noah's descent from the Ark until Lot's flight from Sodom and God's re-naming of Abram, nature strove with the Holy Spirit in man, and God finally gathered the Holy Seed into the body of Abram, thereby regenerating him, so He re-named him and called him Abraham. Thus transpired the second sealing of the soul.

Seal of the Twelve Tribes of Israel.—From Abraham until the move into Egypt is prefigured the third seal of the soul, when man's self-reliance was broken and his spirit made to seek a force greater than that within himself. Joseph is here made the bright and shining light, the husbandman of all that was great and good.

Seal of Aceldama, or Bloody Seal.—From Joseph through years of cruel servitude and oppression, until the birth of Moses, again rolled the seed through man, winnowing itself and gathering force to be gathered in the bosom of Moses, the coming leader of the people of Israel and servant of God. So God has typified the fourth sealing of the soul.

Seal of the Holy Stones.—From the birth of Moses until the crossing of the Red Sea and the destruction of the Egyptian host, passes the fifth sealing of the seed and sealing of the soul, God leading his people from their religious rites and superstitious observances in Egypt, and preparing them for a higher, holier religion.

Seal of the Prophet.—From the Red Sea to the promised land occurs the sixth sealing of the soul. Here was given the law of boundaries and limitations, and the soul was turned back upon itself and forced to prove the sincerity of its faith and beliefs.

Seal of the Sun.—From the promised land until the coming of John the Baptist and Jesus Christ, passes a period which marks the seventh sealing in the existence of the soul. During this period arose many prophets who were the spiritual fathers in Christ to the people, preparing gradually for the final development of the perfect Christ, the Redeemer of all mankind, God's regent upon earth.

The soul must pass through all these stages of purification before it can enter the Christ, after which it passes into the priesthood of Melchizedek.


SPIRIT
WATER


Decem.
novem.
June.
July.

Unfortunately, the particular chart on which he illustrated this Progress of the Holy Spirit was destroyed. He made twelve of these charts altogether, one for each of the tribes of Israel, but he tore up all but four, three of which were happily given away, so that he has one only in his possession now. During the summer and autumn of 1886 he worked several months on these charts, elaborating them with the greatest care. They were all colored in the most delicate manner with water colors, and the delicate shadings make it extremely hard to give in black and white an adequate idea of the beauty of the design. Two of these charts are here given, being reproduced from photographs. He has made no such elaborate description of these as of the first one, but the design with the dove in the centre corresponds with some closeness to the one whose description has been given. In the centre is the dove representing the Holy Spirit, and surrounding it are the different crosses given in the *Arcana Vitae*, and a close study will show the seven crosses, most ingeniously worked together. It is probable that in looking at the design closely for the first time one will suddenly see a new cross take shape before his eyes, and this indeed is what the patient says occurs with him. In describing the crosses he will say, for example, that in drawing the cross of St. Andrew the lines suddenly took a new shape and he found he had also made a cross of St. Michael. This to him is a matter of deep significance, and he feels that his work is directly controlled by a higher power, and that the work of his fancy is really inspired.

Outside these central crosses are the names of three ancient deities who were each characterized by some special attribute, and under these the parts of the

body that Mr. G. conceives these deities especially to have represented, and then comes the name of the Biblical personage in whom these elements were finally exemplified and embodied. To the left of the dove is Venus, representing Blood, exemplified in Moses; above is Osiris, representing Flesh, embodied in Adam; and to the right Psyche, representing Water, typified in Noah. These three are but the gross and material parts of Man, representing indeed necessary steps in his progress through life, but secondary and subordinate to the higher part of his nature represented by Truth and the Spirit,—which received their ultimate embodiment in *Christ*.

The Lion, denoting Might, and Eagle, signifying Emulation, are the same in this design as in the first, but it is uncertain just what symbolism is connected with the serpent twining about the cross, and the open book crossed by a sword and pen, unless indeed this last may mean the Bible with the emblems of peace and war lying quietly within it, and it seems not unlikely that the serpent is emblematic of the Betrayal. For the rest of the design, however, we need make no inferences, as it corresponds closely with his description.

Outside of the circle enclosing the crosses are the seals, sealing the Holy Spirit. In the large light triangles, or rather rays of the sun, are given the names of the twelve apostles, forming the SEAL OF THE PROPHET. Above these, in the same space, are the signs of the zodiac in the extreme points of the triangle, with the names of the parts of the body underneath that these signs correspond to in the ancient mythology; this forms the SEAL OF THE ZODIAC. Between these large light colored triangles are the

twelve holy stones, represented as ovals, and with their names plainly distinguished in the cut, making the SEAL OF THE HOLY STONES. In the small triangles directly above the Holy Stones are given the names of the twelve tribes of Israel, but the color of these in the chart (vermilion) is such that the lettering does not come out in the photographic negative. This gives the SEAL OF THE TWELVE TRIBES. Directly beneath the Holy Stones, filling in the space between the bottom of each large triangle, is the SEAL OF THE GERM, colored dark green, and running down on each side of the top of these large triangles are small triangles, colored dark red and forming the SEAL OF THE ACELDAMA OR BLOODY SEAL. On the circumference are the names of the constellations of the zodiac and directly under these the names of the corresponding months of the year, and under these again are the mythological representations of the constellations, Leo (July) being at the top, and then in order to the right come Virgo (August), Libra (September), Scorpio (October), Sagittarius (November), Capricornus (December), Aquarius (January), Pisces (February), Aries (March), Taurus (April), Gemini (May), Cancer (June). This gives the last sealing of the Seed, the SEAL OF THE SUN.

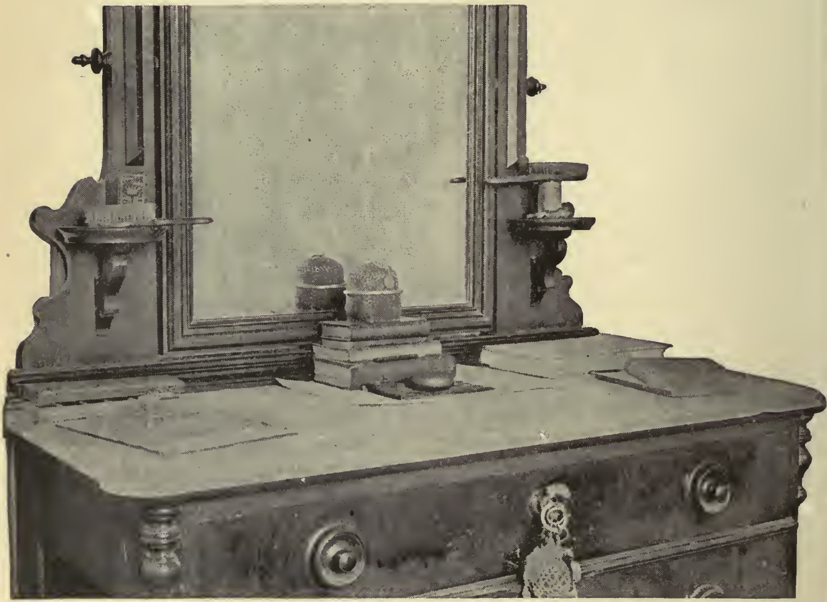
It will be seen that beginning at the circumference at any point and going toward the centre there is a complete astronomical representation of the season of the year, first the name of the constellation, then in succession the month, the constellation depicted pictorially, the sign of the zodiac and the part of the human body corresponding in the old astronomy to this sign of the zodiac.

The second chart is by no means so elaborate as the first. In the centre is a representation of St. George

slaying the dragon, and surrounding this, beginning at the left, are inscribed the legends *Faith*, *Hope*, *Charity*, *Love*. Here again the colors in the original are such that the lettering does not come out well in the photographic negative.

After finishing these symbolic religious charts, Mr. G. had a long period of inactivity, giving up painting and drawing completely, and spending much time in reading the Bible. During these inactive periods he lies down a great deal of the time, lying flat on his back and looking upward; and he often has a cane or some small article in his hand that he twirls or tosses. This inactive period lasted for several months, when he again took up his artistic work, this time modeling in wax. After making several small designs he began and completed two large representations of *Comedy* and *Tragedy*, illustrations of which are given from photographs of the plaster casts given to the writer. His passion for the odd and fantastic is here again well exemplified.

An excellent conception of his mental twist can be obtained from a description of his room, for here his fancy has been given full play and he has been permitted to decorate this as he chose. Over the inside of the door hangs a curtain on which are stitched various designs cut out of red cloth. The curtain is made of three pieces of gray, yellow and red flannel, and in the centre is the word CHARITY, with a sword piercing it through the centre. Below this is Fortune's wheel, and under this three turtles. On the upper third is a dragon, with a full moon in the left hand corner, and the designer's initials woven fantastically together. A bat with outstretched wings is on either side of the centre design.



Behind this curtain several months ago, but since taken down, he had placed a horse-shoe to which was attached a small chain, through which passed a piece of bamboo on one end of which was a piece of castor and on the other several bits of wire. These, as is the case with everything he thus puts up, all had some symbolic meaning, but he took offense if they were ever alluded to.

On the outside of the door is tacked up a circle cut from thin wood with a scroll saw. At the four quadrants of this the circumference is broken by the projection of a portion of the wood in such a way that the four together form the ends of a Greek cross; but instead of the cross being continued through the circle, the interior of this is taken up with an elaborate design, delicately sawed out, in which is woven the letters A and ω, alpha and omega. The design is brought out clearly by being placed over red paper, and a little red paper triangle is placed at each end of the cross, thus forming a cross of a different kind.

On the head-board of the bedstead he has placed a circle carved out of soft wood and with the rays gilded to represent the sun; and in the centre of this in a somewhat intricate design are the symbols A and ω again, alpha and omega. This emblematic sun comes directly above his head when lying down. (In photographing this the camera had to be placed at the side so that the circle is distorted.)

His bureau is always arranged with the most scrupulous exactness, every article having its particular place. When the photograph of the bureau was taken there were not so many trifles on it as there have been at other times, but the illustration shows well the systematic order in which everything is placed, and

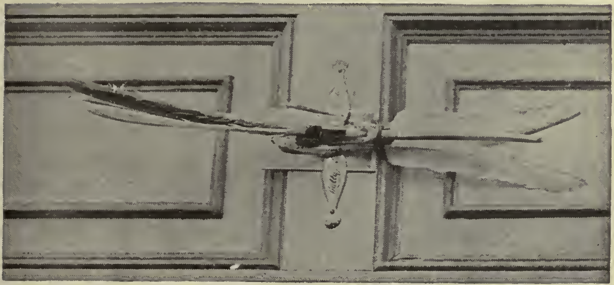
on this occasion no special arrangement had been made, but it was in its usual condition.

While in his room he wears a green soft felt hat decorated with a feather and his modeling stick, and on leaving his room this is always placed over his water pitcher as shown in the cut. There are much fewer articles on the hat now than in the summer of 1886, when he had covered the hat with the following articles: two steel watch chains, nine buttons, a child's toy tin spoon and plate, part of a suspender buckle, two brass covers to cachou boxes, one ladies' rubber hair pin, one necktie clasp, two brass labels from a fruit jar; the point of the hat was surrounded with a large steel ring, and the edge was turned up at the back and tacked to the hat with a fancy Japanese button. The green ball on the bureau, over which the steel ring is placed, was formerly in the crown of the hat.

At this time he was wearing a pair of sandals (originally suggested for surgical reasons), and he never left his room without placing these sandals in his room and standing his clothes brush on them at a certain angle.

The light felt hat shown in the cut he has at present discarded, wearing only the green one; the decorations on this light hat approach somewhat those formerly on the green one.

On the window casing he has fastened some feathers, a tooth-brush handle, one of his modeling sticks and a rubber hair pin, all secured together by a pair of confectioner's tongs. Any disturbance of the articles in his room, or any comment on them, greatly distresses him and he gives an abrupt answer and turns the subject, and with the exception of the medical




b
ab

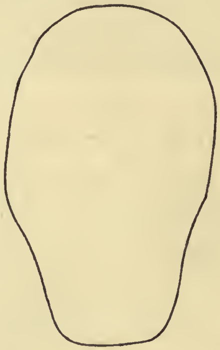
staff and the attendant who cares for the room, no one enters it.

The fall and winter of 1887–88 were marked by no artistic efforts on his part, but during the spring he took up his painting and carving and now (April 1888) he does some work each day. He has just finished a series of 12 water color sketches, and seven of these are here given to show in some degree his high artistic ability. Of the six represented in one group, the one in the upper left hand corner is THE WOLF SLAYER, then comes PUCK, then SHECHINAH or THE LIGHT OF LOVE, Shechinah meaning to the Jews that miraculous light or visible glory which was a symbol of a divine presence. In the circle in which the *S* is elaborately drawn is also the word *Abba, Father*. Of the three lower ones the one at the left is ST. MICHAEL, the next ONE OF THE FATES, and the last the angel SANDALPHON, with the Holy Grail at the side, and the letters Alpha and Omega at the top (the design must be inverted to make out the Omega.)

The coloring on all of these is delicate and harmonious, but none of them equal in grace the picture of LUNA ; the background of this is a delicate blue, and the effect of the light and graceful floating figure is very striking. This was the last of the series of twelve to be finished and the one that he takes most pride in.

While working on these sketches he made at the same time the design for a book-plate, representing Cupid learning the alphabet, and the entire design, he says, is full of symbolism—a favorite word. Cupid has his finger on *Alpha*, signifying the beginning of his education ; above the book is Cupid's target with a heart for the centre, that he has pierced with an arrow, while the full quiver stands to the right. The

curious fish under the *Veritas* represents the ΙΧΘΥΣ of the early Christians, while three crosses symbolic of the Christian religion are in the upper left hand corner, brought out by heavy shading of the cross lines. On the book of knowledge is perched the dove, emblematic of purity, while the olive branch at the left of the book and the palm under the Fool's Bauble give still other religious symbols. The lamp of knowledge is burning brightly in front of Cupid, while at his feet are the square, compass, triangle and pencils, symbolizing the designer's profession.



In appearance he is of medium height, well formed and muscular; light hair, which he keeps cut close to his head; and light moustache; his head is short and round, with but little occipital protuberance. The most striking peculiarity is the decided asymmetry of the face that is noticeable at first glance. The right eye and eye-brow are higher than the left, and also the right side of the mouth, and when he laughs this is especially noticeable. The nose, which is well formed and large, deviates slightly to the left. The left ear is smaller than the right and lies close to the head, while the right turns outwards. The whole right side of the head appears larger than the left, and this is

shown by the accompanying map of his skull taken by a hatter. There is a wide range of normal variations in skulls, but in the present instance it seems not unfair to connect this with the other evidences of asymmetry. In walking his head is invariably tipped toward the left shoulder, and in addition his hat is tipped still further to the left, so that the one-sided appearance is very noticeable. Besides these peculiarities he carries his left hand in his trousers pocket in summer and in his overcoat pocket in winter, while he swings his right arm vigorously to and fro. It should be said, however, that when he had *mania a potu* in Paris he cut his left hand badly, and in consequence the fingers of that hand are somewhat contracted and the circulation is poorer than in the other, which may account in part, if not wholly, for his habit with respect to carrying it.

His mental condition at present is one of mild exaltation. He whistles and sings some, but not enough to cause annoyance. For a time he discontinued work on the drawings of the *Arcana Vitae* and began carving some designs on the outside of a wooden chopping-bowl. On two sides appears the sign I H S woven together into a monogram and surrounded by rays representing the sun; and in another place A M for Alma Mater and Alpha and Omega, the M being reversed into W. Other symbolical designs are drawn on the sides of the bowl, and he spent several hours each day carving. His present work is the carving of another wooden bowl, with a lion's head in the centre and the legend *Pro rege in tyrannos* surrounding this, with elaborate tracery designs on the sides. He is perfectly willing to stay in the institution because this is part of his discipline and he must take the good

and bad alike. Insanity is only a relative term, he says, and every one has to pass through a condition in which they are what is commonly called insane, but it is all for their own good and they must not question the designs of Providence. When the time comes for him to go out he will go, he says, and until then is perfectly willing to remain. To the ordinary observer he appears to be a bright, intellignt man; somewhat given to oddities of dress to be sure, but without the striking peculiarities of speech and manner that the laity expect in a case of mental disease. There is but little mental enfeeblement, and none that would be noticed in an ordinary conversation, but he is unable to apply himself continuously, and months at a time may go by without his lifting a pencil or brush. He is bright and interesting in conversation, and a capital mimic. He recognizes the delusions of other patients and often tells of them with much enjoyment.

A few words only need be said as to the place the case should occupy in any scheme of classification of mental diseases. The slow and progressive course, the original mental twist in the direction of the odd and fantastic in art, the cranial anomalies, the evolution of systematized delusions, and the periods of delirious grandeur followed by morbid depression, make it a typical case of *Primäre Verrücktheit* of the German authors, or of *Paranoia* of the Italian and French school; or of the *Monomania, Primary Monomania*, or *Primary Insanity* of the American and English writers. Of all these terms that of *Paranoia* is much to be preferred, and it is hoped that this word may find a definite place in the classification of mental diseases.


GOOD GOD·
VERITAS
GOOD DAY·
GOOD - NIGHT·
GOOD MORROW·

SOME EFFECTS OF STIMULATING GANGLION CELLS.

Preliminary Communication.

C. F. HODGE.

The aim of this series of experiments has been to ascertain to what extent changes due to the functional activity of the nerve cell can be seen by aid of the microscope. The work is based on the fundamental idea in all cell activity, viz. that in the resting state the cell elaborates highly complex compounds, and that these break down to yield the energy by which the cell does its work. These processes have been studied and successfully demonstrated by others in certain gland cells. We applied similar methods to their study in nerve cells; thinking it would be strange if they should prove undemonstrable in cells so large, so definitely characterized, and which stand in so vital a relation to the energy of the animal body.

For this purpose we have used the posterior root ganglia. Fifteen experiments were made on frogs. One, the last experiment, was made on a cat.

The preliminary question as to the minute structure of the ganglion demanded attention at the outset. Mr. Nelson, working under the direction of Dr. Birge at the University of Wisconsin, counted the fibres in the

posterior root and the cells of the corresponding ganglion of the frog, expecting to find, as Birge had found for the anterior root and motor cells, one cell for each fibre. He counted about ten ganglia and, allowing 2 to 4 per cent for error in counting, found *two* nerve cells to the fibre. This would indicate a more complex structure of the ganglion than Ranvier supposed. To study this point we teased the ganglia, using a fine jet of water instead of needles, and obtained preparations which we think demonstrate the following points:

1. Typical bipolar cells do occur, two having been found.

2. The axis cylinder of the process is often seen to divide and enter the cell as a spiral and a straight fibre.

3. At the angles of the "T" the axis cylinder of the cell process may be seen to divide and pass both ways in the nerve fibre, of which it *seldom* forms the *whole* of the axis cylinder.

4. Two cells, in a number of cases, have been found to unite their processes, not necessarily as a cell junction, but to aid in making up the axis cylinder of the same nerve fibre.

If two cells are connected with a fibre in this way, we see no reason why more may not be. So that we may conclude, whatever the number of cells in the ganglion, that our stimulus applied to the nerve trunk will reach them all. They probably function as bipolar cells.

Stimulation Experiments.

Results of these may be briefly summarized.

Four experiments, on frogs, in which curare was used, gave no decisive results.

Five experiments, in which the circulation was disturbed, *i. e.* where the frogs were bled or the capsules

of the ganglia torn off with a view to prevent rejuvenation of the cells, gave unsatisfactory results. See Table I.

Before referring to the tables it should be stated that several observers arrived independently at the conclusion that the nuclei of the stimulated cells looked smaller than those of the unstimulated. This led to the series of measurements given in the subjoined tables. The nuclei were measured, long and short diameters, in sets of one hundred each; fifty stimulated and fifty unstimulated being taken from as nearly corresponding sections of the two ganglia as possible. The measurements were made to the nearest μ under a magnifying power of Leitz Oc. 3, Obj. 7. (=600 diameters). The diameters were put down in series, then averaged, and this average is given in the tables.

Table I.

Frog No. 8. Bled. Stimulated 7 hours; five minutes of stimulation alternating with five minutes of rest.

One set of 100 nuclei. Ganglia hardened in corrosive sublimate.

Average Diameters in μ.

	Long.	Short.	Mean.
Resting	14.41	10.09	12.25
Stimulated	13.80	10.21	12.00

Staining, structure of protoplasm, etc., not distinguishable.

One experiment, in which the ganglia were suspended in normal salt solution while being stimulated, gave very fair results.

TABLE II (Condensed).

Frog No. 14. Ganglia stimulated, while suspended in normal salt solution, 3½ hours, five stimuli per second, one minute of stimulation alternating with one minute of rest.

Two sets of 100 nuclei each.

	Average Diameters. Mean.	*Remarks.*
9th pair of ganglia, hardened in corrosive sublimate.	Resting......15.06 Stimulated...13.62 Diff. 1.44	1st set. Measured by myself *previous* to Mr. W.'s measurement of 2d set.
	Resting......14.34 Stimulated...12.12 Diff. 2.22	2d set. Measured by Mr. W. *without knowledge of my results*, and having but one of the ganglia in field at the same time, and *not knowing which had been stimulated* and which not.
Set 1 and 2.	Resting......14.70 Stimulated...12.87 Diff. 1.83	

Treating the nuclei as spheres, and computing the volumes from the mean diameters, we have per cent of shrinkage in bulk of nucleus (resting, 100 per cent; stimulated, 67 per cent) 33 per cent.

Differences in staining and appearance of protoplasm not clearly in agreement with those found in frog No. 7 and cat. Treated by Gaule's quadruple staining method, the stimulated cells stained somewhat redder with eosin than the unstimulated. (See remark on staining under Tables III and V.)

The best results were obtained from experiments in which the circulation was kept most normal (see Tables III and V). Table IV gives only a fair showing for frog No. 15, the experiment being not altogether successful.

Table III.

Frog No. 7. Made reflex. Stimulated 2½ hours, intervals of rest and stimulation being two minutes.

Three sets of 100 nuclei each. In set 1 the cells were also measured.

		Nuclei. Average of 50 Diameters. Long.	Short.	Mean.		Cells. Diameters. Mean.
8th pair ganglia. Hardened in corrosive sublimate.	Resting......	16.09	12.50	14.29	1st set.	39.69
	Stimulated ..	13.62	11.47	12.54		35.00
9th pair ganglia.	Resting......	15.97	12.08	14.03	2d set.	
	Stimulated ..	14.81	10.44	12.62		
2d pair ganglia.	Resting......	15.78	11.47	13.62	3d set.	
	Stimulated ..	14.25	10.53	12.39		
	Resting......	15.94	12.02	13.98	Sets 1, 2 and 3.	
	Stimulated ..	14.22	10.81	12.51		

Per cent shrinkage in volume of nucleus, computed as above, 33 per cent (resting, 100 per cent; stimulated, 67 per cent).

It was in this series that the nuclei first appeared shrunken in the stimulated cells.

Staining somewhat lighter in stimulated cells, due to—

1. Protoplasm of stimulated cells less densely and coarsely granular and much vacuolated.

2. Nuclei more distinct in stimulated than in unstimulated cells.

Table IV.

Frog No. 15. Cerebrum removed and wound allowed to heal before the experiment. Stimulated 5½ hours at a temperature of + 35° C., intervals of stimulation and rest being one minute.

Three sets of 100 nuclei each.

	Diameters. Mean.		Remarks.
Ganglia of 2d pair, hardened in picric acid.	Resting......16.94	1st set.	*Set* 1 was measured by myself previous to measurement of second set.
	Stimulated ..16.00		
	Diff. .94		
	Resting......16.81	2d set.	*Set* 2 was measured by Mr. L. without *any knowledge* as to my own previous measurement and with *no knowledge as to which of the ganglia had been stimulated.*
	Stimulated ..15.47		
	Diff. 1.34		
9th ganglia. Flemming.	Resting......20.74	3d set.	It will be noted that both Mr. L.'s and Mr. W.'s measurements (Table II) make the difference between stimulated and unstimulated nuclei somewhat greater than my own.
	Stimulated ..19.53		
	Diff. 1.21		
	Resting......18.16	Sets 1, 2 and 3.	
	Stimulated ..17.00		
	Diff. 1.16		

Volume shrinkage 19 %.
Resting....100 %
Stimulated 81 %

Staining and structure of protoplasm not well defined; probably due to the fact that the frog died toward close of experiment. At its close the muscles were beginning to pass into rigor mortis. Stimuli used excessively strong.

Table V.

Cat No. 1. Optic thalami punctured. Stimulated, one minute of stimulation alternating with one minute of rest, for 7 hours.

Two sets of 100 cells and nuclei each.

1st set.

		Nuclei. Diameters in mm. Long.	Short.	Mean.	Shrinkage.	Cells. Diameters. Mean.
1st dorsal, hardened with osmic acid.	Resting....	18.16	14.75	16.45	100%	59.06
	Stimulated..	15.84	12.44	14.14	62%	57.19
				Diff. 2.31	38%	

2d set.		Nuclei. Diameters in mm.				Cells. Diameters.
		Long.	Short.	Mean.	Shrinkage.	Mean.
7th cervical, hardened with Flemming.	Resting	17.34	15.53	16.44	100%	57.50
	Stimulated	16.28	14.37	15.32	80%	56.25
				Diff. 1.12	20%	

Sets 1 and 2.		
Resting	16.44	100%
Stimulated	14.73	71%
	Diff. 1.61	29%

The difference between sets 1 and 2 may be due in part to the different hardening agents used. It is probably due in part also to the position of the nerves between the electrodes; the nerve from the 1st dorsal coming first in the circuit, that of the 7th cervical third.

Staining, in general, lighter in the stimulated ganglion.

The experiment on the cat was the most satisfactory of all, both as to operation and results. As anaesthetics are a disturbing factor, the optic thalami were punctured during slight anaesthesia from *ether*. The pulse and respiration remained normal during the whole experiment. The right brachial plexus was laid bare in the axilla and stimulated, one minute of stimulation alternating with an equal time of rest, for seven hours. The cells of the stimulated ganglion show extreme vacuolation, whereas scarcely any is observable in the unstimulated. The nuclei, besides being smaller, are more irregular in outline in the stimulated than in the resting cells. It was noted independently by three observers that the nuclei of the capsule were shrunken in the stimulated cells.

The principal results thus far may be summarized as follows:

1. The nucleus and cell body both decrease in size as a result of stimulation.

2. The protoplasm of the cell becomes vacuolated as a result of stimulation.

3. Differences appear in staining.

These experiments have been made under the guidance of Dr. H. H. Donaldson, Associate in Psychology in the Johns Hopkins University.

BALTIMORE, April 26, 1888.

PSYCHOLOGICAL LITERATURE.

I.—HISTOLOGY OF THE NERVOUS SYSTEM.

The Structure and Combination of the Histological Elements of the Central Nervous System. FRIDTJOF NANSEN. Bergens Museums Aarsberetning for 1886.

This paper of nearly two hundred pages is in English and contains the author's views of the minute structure of nerve cells and fibres, chiefly in invertebrates. There are eleven plates. From the study of species of mollusks, Chaetopodes, Oligochaetes, Crustaceans, Ascidians, and the two low vertebrates, Amphioxus and Myxine, he states the following: All nerve fibres, or nerve tubes, as Nansen prefers to call them, contain one or more primitive tubules. Under certain circumstances these nerve fibres have been described as containing fibrillae floating in a liquid contained by the sheath of the fibre. The author rejects this view and presents his evidence for one which differs from it. According to the view given, the nerve fibre is a tube. The subdivisions within the fibre are the "primitive tubules," and these contain the "hyaloplasm" which is the true nervous substance. The primitive tubules are the meshes in a supporting substance designated as "spongioplasm," a substance described as similar to the neuroglia which forms the sheath of the nerve tube or fibre. We have then within the nerve tube the primitive tubules, the wall of each tubule being formed by this spongioplasm.

In the study of the cell, Nansen finds that one principal constituent of the protoplasm of the cell is the primitive tubules, which have there the same structure that they have in the nerve tubes. The course of these primitive tubules within the cell is but partially made out, but they can be seen at times to run in circles about the nucleus, and thus give to the cell the concentrically striated appearance which has often been described. Beside this there is a spongioplasmic reticulation in the cell body, so that the hyaloplasm filling these reticulations and that in the primitive tubules go to make up the protoplasm of the cell.

Regarding the nature of the cell processes, Nansen follows Golgi in every particular. All the processes save one are protoplasmic, and these have probably a nutritive function. The remaining prolongation, the axis cylinder process, is always branched and belongs to one of two types: that where the identity of the axis cylinder is almost at once lost by profuse branching, or that in which it gives off branches but at the same time maintains its identity and passes to the periphery.

The author next proceeds to the examination of the dotted substance of Leydig. He concludes that it is formed of tubes and fibrillae which do not anastomose with each other, but form a close web or plaiting. The term fibrillae is used in this case to designate very fine

primitive tubules and also fine prolongations of neuroglia substance. The meshes of the dotted substance, as described by other authors, are only the transsected sheaths of the tubules, and the inter-fibrillar substance is hyaloplasm, the true nervous substance filling the tubes.

Lastly the author gives a scheme for the course of an impulse in a reflex action. The impulse starting from the periphery passes by the cell on the posterior root ganglion, and enters one of the branches into which the sensory fibre divides in the cord. These branches of the entering fibre are assumed to be in connection with at least the branches from the two sorts of cells which, according to Golgi's classification, are there present. Nansen gives reasons for thinking that the impulse does not enter the sensory cell of Golgi. The entering branches being, however, connected with the branches of the motor cells, it is assumed that the impulse travels from the sensory network through the lateral branches of the axis cylinder prolongation of the motor cells. At this point two courses are again open to it. It may either pass up into the motor cell or out along the prolongation. Nansen thinks that the latter course may be the one taken. As is plain, this view relieves the cells from any direct connection with such an impulse. The role suggested for the cells thus thrown out of employment is that of nutritive centres.

The investigation represents much careful study, as far as the histology is concerned, though the presentation could have been condensed with advantage. Against the speculations at the end of the paper there is certainly some positive evidence from the peculiar irritability of nerve cells as compared with that of other elements of the nerve centres. On the other hand, the hypothesis needs for its support either the assumption that the tubules or fibrillae form T branches in the neighborhood of the cell, or else that the conduction in the fibrillae or tubules is not isolated ; and so far as known, there are no histological facts which favor either of these assumptions.

Das zentrale Nervensystem der Acephalen. B. Rawitz. Jenaische Zeitschr. für Naturwissenschaft, B. 20 (N. F. B. XIII), H. 2 und 3, 1887, pp. 385–460. 21 Tafeln.

The author studies the nervous system in the Acephala with the main view of getting a better means for classification within the group. The result of his investigation is to place the Ostreacea at the head of the group because of the highly differentiated visceral ganglion which it possesses. On the way the paper touches many points in comparative neurology. Regarding the form of the ganglion cells, R. is a vigorous supporter of the unipolar cells. The connection of this cell with others may be considered to take place through the network into which the single nervous prolongation is considered to break up. Other cells are described which have only protoplasmic prolongations. Cells are figured as uniting with one another by these latter.

The principal prolongation, where it exists, is considered as the homologue of the axis cylinder or Deiters prolongation, and is described as passing toward the centre of the ganglion. In a few cases the prolongation passes on to a nerve, but in the majority it breaks up into a network in the centre of the ganglion, and from this network the fibres arise. The fibres are simply groups of axis cylinders separated by a homogeneous medium and enclosed in a connective tissue sheath. A ganglion consists of several layers of cells surrounding a

central medullary substance. Both cells and central substance contain something resembling myeline. This myeline separates the fine varicose fibres which make up the truly nervous part of the central substance. This latter is considered as the homologue of the white matter in the vertebrates. No structure is found which corresponds with the neuroglia of the vertebrates.

There is a detailed account of the course of the fibres in the ganglia in different forms, and also several generalizations as to the function of cells from their form and arrangement. The reviewer finds the evidence inconclusive on many of the points stated above.

Zur Anatomie des Nervensystems der Gymnophionen. J. WALDSCHMIDT. Jena. Zeitschr. für Naturwissenschaft, Bd. XX, S. 461.

Under Wiedersheim's direction the author has made a study of the brain and cranial nerves in this interesting order of the amphibia, the representatives of which have rudimentary sense organs and no limbs. The olfactory division of the fore-brain is well developed, the cerebral hemispheres not remarkable, the inter-brain very poorly developed, the mid-brain undivided, the hind-brain wanting, and the after-brain moderate. The pineal gland is very rudimentary. Of the cranial nerves down to the tenth, the second is rudimentary, corresponding with the very poorly developed eyes; the fourth and sixth cannot be found, and the eighth, if represented at all, is only present as the merest rudiment, corresponding with the absence of any auditory mechanism. The chief interest centres in the first pair. There are two roots from each olfactory lobe, a ventral and dorsal. The former is best developed. In the opinion of W. the ventral represents the pair usually found in the vertebrates, while the dorsal roots have been secondarily acquired by this order, which is practically reduced to this single special sense of smell. The condition of the parietal eye as indicated by the very rudimentary state of the pineal gland and the absence of any parietal foramen, is also a point of interest.

Do the Nervi Erigentes leave the Spinal Cord in Anterior or Posterior Roots? GASKELL. Proceed. of the Physiological Society, 1887, No. 1, p. 4. The Journal of Physiol. VIII, 1.

Opinion on this point has been divided. The author stimulated the peripheral portions of the sacral nerve roots in six rabbits. The anterior roots of the second and third sacral nerves caused an erection when stimulated. The stimulation of the posterior roots produced no effect. The inference drawn is that vaso-dilator fibres are to be looked for in the anterior nerve roots.

Zur Anatomie des Froschgehirns. M. KOEPPEN. Neurolog. Centralbl. No. 1, 1888.

In Schwalbe's laboratory and under his direction the author has studied the normal anatomy of the frog's brain by Weigert's haematoxylin method and carmine staining. In the preliminary account here presented the principal results are summarized. The vagus, trigeminus, and acusticus all have large ascending roots, which in the case of the vagus and trigeminus are double. The main ascending root for the vagus is in the lateral column, almost the entire column being used in this way, while for the trigeminus it lies in

the dorsal column; the minor ascending root for these two nerves is found in the dorsal cornua. The acusticus has a three-fold origin, (1) general nuclear mass at that level; (2) from large cells which are the representative of the nucleus of Deiters; (3) from a round nucleus in the dorsal part of the gray matter. The large cells stand in connection with the roots of the acusticus on the one hand, the root fibres being large, and on the other appear to connect with the largest fibres in the cord, these latter running in the ventral columns and entering the ventral nerve roots. This is supposed to represent part of the mechanism for the equilibrium centre. Fibres lying in much the same position as Mauthner's fibres in the fish are found and homologized with the posterior longitudinal bundle. There are no uninterrupted tracts to the fore-brain, and there is nothing corresponding to a pyramidal tract. There is a well developed ventral commissure, an inferior olive, and the system of fibres in the fore-brain is complicated, but the individual fibres are not brought out by haematoxylin. K. confirms the existence of a corpus callosum. The olfactory nerves start from masses of fibres in the glomeruli, there being no cells in these glomeruli, and the olfactory nerves are partially crossed.

Ueber die hinteren Nervenwurzeln, ihre Endigung in der grauen Substanz des Rückenmarkes und ihre centrale Fortsetzung im Letzteren. BECHTEREW. His. und Braune's Archiv, 1887, No. 2 u. 3, S. 126.

The author investigated the foetal cord in man. He distinguishes two groups of fibres entering by the posterior nerve roots: one, early medullated (about the fifth month) with fibres of large caliber and lying mesial, the other becoming medullated later, with fibres of small size and lying lateral. The former appear on entering the cord to run mainly to the ventral portion of the column of Burdach, the latter goes chiefly to the most posterior part of the lateral column, the marginal zone (Randzone) of Lissauer. Both groups send small portions directly into the gelatinous substance. After a longer or shorter course all the fibres of the posterior roots enter the gray matter. There are no root fibres which pass directly to the oblongata. The following is the central course of the two components of the posterior nerve roots. The fibres of the mesial bundle pass in several directions after entering the gray matter; one part goes to the column of Clarke, another to the anterior cornu of the same side, to there unite with the cells; and a third to the anterior cornu of the other side, passing through the anterior commissure. The fibres of the lateral bundle pass cephalad for a distance in the marginal zone, then end into the small cells in the posterior cornu. From the column of Clarke there pass out fibres to the direct lateral cerebellar tract, others to the ventral portion of the column of Burdach and in part to the column of Goll, and finally bundles to the anterior cornu of the same side, and through the anterior commissure to the anterior cornu of the opposite side. From the small cells in the posterior cornu pass fibres to the limiting layer (Grenzschicht) and to the column of Goll. In the foetal cord the posterior commissure does not contain any medullated fibres. From these anatomical observations the author draws several physiological inferences which are here passed over.

Verlauf der hinteren Wurzelfasern im Rückenmarke; Aufbau und Degeneration der im hinteren Theile des Rückenmarkes gelegenen, weissen Substanz (bei Tabes). A. Takács. (Original in Hungarian.) Abstracted in Centralbl. f. Physiol. No. 9, 1887.

The main anatomical results of this investigation are stated as follows: 1. One portion of the posterior root fibres enters the gray posterior cornu, and the other portion the white matter about the posterior cornu. 2. Fibres which enter the posterior cornu pass through the substantia gelatinosa and may be followed to the cells in the column of Clarke. 3. The portion running to the white matter enters the column of Burdach and the posterior part of the principal tract in the lateral column, then bends cephalad and disappears in the posterior cornua of the next three roots. 4. A portion of the fibres which come from the cells of the column of Clarke pass divergently into the column of Burdach and later go to form the column of Goll. 5. The second part of the fibres coming from the cells of the column of Clarke passes outside of the gray matter through the dorsal portion of the principal tract of the lateral column, then turning dorsad and cephalad forms the direct lateral cerebellar tract. 6. The direct lateral cerebellar tract and the columns of Goll are thus formed from equivalent groups of fibres, *i. e.* fibres which have passed through cells in the posterior cornua. These fibres pass cephalad in the cord without interruption, and their number of course increases. 7. The columns of Burdach and the dorsal portion of the principal tract of the lateral column are also mainly composed of posterior root fibres which, however, after a short course, as stated above, enter the gray matter of the posterior cornua. The author further describes association fibres between different levels of the posterior cornua.

Die histologischen Veränderung in den peripherischen Nerven, den Spinalganglien und dem Rückenmarke in Folge von Amputation. E. A. Homen. Neurolog. Centralbl. No. 3, 1888.

The author worked on some thirty dogs, from a week old to those adult, and amputated the limbs, usually the hind leg, at the hip or knee. The animals were examined from one day to three and a half years after the operation. The methods used for the histological investigation were those generally employed. In all cases the main change was found in the posterior cornua and the posterior columns of the cord. In those cases involving the lumbar region there was also a slight decrease in the number of cells in the columns of Clarke. The principal change was effected within the first six months, and the first recognizable difference occurred in the youngest and most easily influenced animals at the end of about a week. The operated side then seemed a trifle smaller than the normal. The change took place exclusively in the sensory nerves, but only a portion were involved, and consisted, in part at least, in the shrinking of both medullary sheath and axis cylinder. The spinal ganglia on the operated side were slightly atrophic. In the anterior cornua it was the postero-lateral group of cells which was most affected, and the author looks on them as sensory. Why only a part of the sensory nerves should be affected is not clear. [One value of such an investigation is the light which it throws on the degenerative change, the atrophy which occurs in this case being something quite different from Wallerian degeneration.]

The Cells of Clarke's Column. F. W. Mott. The Brit. Med. Jour., 1887, Dec. 3, p. 1218.

A demonstration of these cells was made by the author from the cords of the dog, monkey, and man. The cells were bipolar or vesicular, and the long axis coincided with that of the cord. Axis cylinder and processes large. Caudad the cells were connected with the postero-lateral column, while cephalad and laterad they could be seen to be connected with the direct cerebellar tract. The results of degeneration in this region were also demonstrated.

Vergleichend-entwickelungsgeschichtliche Studien im Bereich der Gehirnanatomie. 1. Ueber die Verbindung der sensibeln Nerven mit dem Zwischenhirn. L. Edinger. Anatomischer Anzeiger, II, 6.

The author studied blindworms about twenty days old by Flechsig's method, and found that the nuclei of the sensory cranial nerves (trigeminus, glossopharyngeus, vagus, acusticus) have, just like the nuclei of the posterior columns, a connection with crossed centres that lie cephalad of them, by means of fibres. The fibres from the nuclei, after crossing the middle line, unite laterad of the posterior longitudinal bundle and pass to the inter-brain in the lemniscus. The relations of this sensory tract are similar in man.

Le système nerveux grand sympathique de l'Ammocoetes (*Petromyzon Planeri*). Ch. Julin. Anatomischer Anzeiger, II, 7, 1887.

The dorsal and ventral roots arise from the cord in Petromyzon in such a way that they are not mixed, but each nerve has a separate distribution. The dorsal roots have each a spinal ganglion, and both dorsal and ventral roots give rise to a dorsal and ventral branch. In the alimentary tract, and in the auricle of the heart, groups of nerve cells were known to exist. This represents the main bits of information possessed previous to this investigation by Julin. He has found something corresponding to a sympathetic system, which is described as follows: Between the cardinal veins and the aorta lie groups of ganglion cells which exactly correspond in position and number to the individual spinal nerves and are connected, one ganglion to the ventral branch of each nerve. Fibres connecting these ganglia with one another have not been found. The segmental ganglia have, however, fibres which connect them with a deeper series of non-segmental ones that are connected with the heart, alimentary tract, kidneys, and the reproductive organs.

The sympathetic in Petromyzon has therefore two peculiarities. The ganglia forming it are not united by a sympathetic nerve, and since there is a ganglion for each nerve root, and the dorsal and ventral nerve roots are separated, the motor and sensory elements in the sympathetic may be considered as also separate.

Sur les nerfs craniens d'un embryon humain de trente-deux jours. Phisalix. Compt. rend. CIV, 4, p. 241.

In a human embryo of thirty-two days the author thinks he can make out the spinal type in certain cranial nerves. The trigeminus has besides the motor portion, which is applied to the ganglion Gasseri, another motor portion which passes through the ganglion. The trochlearis appears mixed, receiving sensory fibres from the corpora quadrigemina.

Sur l'ontogénèse du cervelet. E. LAHOUSSE. Bull. de l'académie royale de Méd. de Belgique, IV Série, I, 4, p. 378; Rapport officiel delivré par M. Rommelaere.

The author has found that the histological differentiation of the spinal cord precedes that of the cerebellum. Ganglion cells, neuroglia and nerve fibres form a united whole. The axis cylinder develops later and in a different manner from the rest of the nerve, namely, from the paraplasm. These results were obtained from the study of sections in the adult and developing chick.

Beitrag zur Anatomie des Taubstummengehirns. J. WALDSCHMIDT. Allg. Zeitschr. f. Psychiatrie, XLIII, 4, 5, S. 373.

In a deaf mute forty-six years of age, who could not write, the weight of the brain was 1440 grams. Operculum gyr. front. inf. and gyr. temp. III. were somewhat less developed on the left side. The left island was much less developed and less convoluted than the right.

The brain of a deaf mute girl, nineteen years of age, also showed the principal difference in the island. In both cases the limen insulae was not prominent. The author lays most weight on the convoluting of the island. In four brains of those not deaf mute (among them two of university instructors), the left island was found decidedly more developed than the right. From which it follows that the deaf-mutism is not necessarily connected with the atrophy of the operculum and the associated parts.

Die anthropologische Bedeutung der frontalen Gehirnentwickelung, nebst Untersuchungen über den Windungstypus des Hinterhauptlappens und pathologischen Wägungsresultaten der menschlichen Hirnlappen. TH. MEYNERT. Jahrb. f. Psychiatrie, VII.

The view of Munk that the frontal lobes are the motor centres for the trunk, and that of Hitzig that they are the seat of logical thought, are both rejected by the author. The weight of the frontal lobe in the percent. of the entire brain mantle is: For man, 42 per cent; ape, 35 per cent; dog, 32 per cent; bear, 30 per cent; a result which gives hardly a satisfactory basis for the view of Hitzig. The increased development of the frontal lobes is mainly due to the increased height of the lenticular nucleus and the island. On the other hand it should be borne in mind that the temporal lobe is proportionately as much developed in man as the frontal. In the carnivora it is the parietal, in the apes the occipital, and in man the frontal lobes which are most developed. The peculiar form of the human brain is due to the upright position in man. The paper contains much other matter bearing on the relative development and separation of the lobes.

Ueber die Localization der Gehirnkrankheiten. H. NOTHNAGEL. Verdl. d. VI. Congresses für innere Medicin zu Wiesbaden, 1887.

N. argues for a moderately detailed localization. In the case of the eye, lesion of the cuneus and the first occipital convolution O_1 causes a hemiopia of the retinal halves on the same side. Injury to the adjacent parts of the cortex causes psychical blindness (Seelenblindheit), or, when excited, hallucinations and the like.

He finds no good evidence for the detailed localization of the retinal elements. It is always a question of hemiopia, with one poorly observed case, where an eighth of the visual field was involved, as an exception.

The author's views on the localization of vision in the cortex are as follows: 1. The cuneus and the O_1 form the field for visual perception. Their lesion on one side causes hemiopia; on both, complete blindness. 2. The remaining occipital cortex is the seat of the visual pictures (Erinnerungsbilder). The limits here are very uncertain. 3. If on one side the cuneus, O_1 and the other part of the occipital region are thrown out of function while, on the other side, the occipital cortex, with the exception of the cuneus and O_1, are thrown out, then there occurs, corresponding to the former lesion, hemiopia and, to the latter, psychical blindness.

The author points out that in the case of the complete cortical paralysis of an arm, for example, patients can often, with the eyes closed, imitate with the sound arm the position in which the paralyzed one is placed. Starting from this fact, the author reaches, as the conclusion of an argument, the view that the centre for what is designated as the muscle sense is in the parietal lobe, while the sensations from the skin are centered in the motor region, about the central convolutions.

The name "psychomotor" for the centres about the central convolutions, for example, is not satisfactory, because a patient with cortical paralysis is capable of the mental process of willing the movement of a part but cannot carry out the operation, hence the psychical progress cannot go on in the part which is destroyed and causes the paralysis. The motor centres of the authors are neither the places where the impulse originates, nor even the place where these impulses are co-ordinated, but merely spots at which they pass over to the coronal fibres. The parietal lobe is to be considered as bearing the same relation to these motor centres that the part of the occipital lobe about the cuneus and O_1 does to the visual centre itself. The author considers this view capable of extension.

I mielociti e il pensiero. C. Golgi. Arch. di Psichiatria, VIII, S. 206.

Pouchet has recently advanced the view that the psychical operations did not take place in the nerve cells proper, but in the small cells, 5–6 μ. in diameter, described by Robin under the name of myelocyts. Against this view Golgi argues that the cells in question have not been proved to be nervous. Pouchet further surmises that each neuro-epithelial element, as in the retina, for instance, is in connection with one of these myelocyts, and then proceeds to calculate that the perception of a moderate-sized object, *e. g.* a letter "X," would at most bring into activity a quantity of gray substance equal to 660 cubic millimeters. Golgi points out that independent cells and groups of cells do not exist in the central nervous system, and that we have no data for placing a limit to the spread of a stimulus.

Physiologische und mikrochemische Beitraege zur Kenntniss der Nervenzellen in den peripherischen Ganglien. Anna Kotlarewsky. Inaugural Dissertation, Bern, 1887.

Following Ehrlich's method, the author has stained the ganglia in the living animal. The small cells stained more intensely than the large, and the reaction appeared to be neutral or slightly alkaline.

The study of hardened specimens showed that the character of the cells could be inferred from the form, and that the chromophile cells always had a greater affinity for the metal solutions than the chromophobe. Staining led to the conclusion that lack of chromatin matter in the nucleus was accompanied by staining of the protoplasm by various reagents.

Sur la morphologie comparée du cerveau des Insectes et des Crustaces. H. VILLAUES. Compt. rend. CIV, 7, p. 444.

In insects and decapods the brain consists of three parts, homologous with three ganglia of the ventral chain. The anterior innervates the eyes; the middle, the small antennae in crabs, the antennae in insects; and the posterior, the large antennae in crabs, the upper lip in insects. Only the halves of the first two are directly united by commissures. The posterior halves are united by the oesophageal commissures. Each of the ganglia is supposed to represent a somite.

II.—HYPNOTISM.

Les demoniaques dans l'art. J. M. CHARCOT (de l'Institut) et PAUL RICHER. Paris, 1887, 116 pp.

This work, richly illustrated with 67 plates, some of which are elegantly produced, is an attempt to trace among the more important works in the history of pictorial art, those which depict hysteria and convulsive diseases generally. The first is a full-page reproduction of a mosaic of Ravenna of the fifth century, representing Jesus healing a demoniac. Miniatures, mural frescoes, bas-reliefs, tapestries, engravings reproduced in various ways and representing exorcisms, energumens, miracles of healing in the New Testament, conversions and cures at the tomb of the Archbishop of Paris, the ceremonies known as *les grand secours* or more or less ceremonious compressions and flagellations, ecstasies, etc., follow, coming down to the middle of the last century. In the fifth and sixth centuries, it is said, such cases had a sacred character. Later, in depicting scenes from the life of the saints, the artists are dominated by a religious spirit. At the time of the Renaissance they followed the development of luxury in the churches; then with the Italian masters, and with Rubens, they have a most sumptuous aspect. The Spanish artists represent everything in the face and in gesture. The school of Breughel reproduces the details of the popular dance of St. Guy. These symptoms are given an anecdotic character first in the time of the convulsionaries of St. Médard. A clinical criticism of the work of the various artists, which is also attempted, represents André del Sarti and Rubens as very faithful to nature, and Raphael as full of untruths and contradictions. The work thus affords a new basis of art criticism, and proves that this group of symptoms is very old. The last few pages are given up to illustrations of the convulsionaries of to-day, exhibiting contortions, "clownisms," opisthotonus, etc., as seen in modern cliniques, as bases of comparison with the above representations of demoniacal possession.

Les maladies épidémiques de l'esprit, sorcellerie, magnétisme, morphimisme, délire des grandeurs. Dr. PAUL REGNARD. Paris, 1887, 429 pp.

This book, which is illustrated with 120 engravings, is, like the preceding work, of a somewhat popular character, but is more miscellaneous. The first part deals with diabolic pacts, the sabbat, sigilla diaboli, magic scriptic characters, and other attendants of sorcery, which is called a creation of despair. Cuts from the seventeenth century show the various forms of attack at home, in the church, on the street, characteristic contractures. The process of the witches' Sabbath is depicted in cuts illustrating the departure, the journey, the transformations, characteristic goblins, parody of every sacred rite of the church, cooking and banqueting on toads and babies. Then follow illustrations representing flagellation, torture of witches, rites of exorcism. A long chapter is devoted to the miracles of Saint Médard, with full and illustrated history of six cases, followed by cuts illustrating similar hysterical paralyses and anaesthesias, meteorism, crucifixion-attitudes, etc., of to-day, curable by suggestion. Much space is devoted to Mesmer and his baquet, which is thought to be related to the monotonous, contemplative asceticism of the fakirs. Minute and illustrated directions for producing each of Charcot's three states show how minutely faithful is the author's discipleship of Charcot, to whom the book is dedicated. Then follow sections on opium, with pictures of all the stages in its growth and manufacture, sale and use. Finally come illustrations, in the form of poems, letters, drawings, script, etc., of delirium of greatness. The pathologic character of each age is indicated as follows: Magic was the epidemic of the fifteenth, sixteenth and seventeenth centuries. St. Médard summarizes the mental maladies of the eighteenth century. Somnambulism began in the seventeenth and has its great field in the nineteenth, the century also of morphonomania and widespread democratic delusions of greatness. The psychic pestilence of the twentieth century may be a delirium of carnage, blood, destruction. In this of course the allusion is to the European war prospects, over-population, and Nihilism.

This work makes almost no pretensions to a scientific character, and as an historical study is of very slight value. We believe its tone and taste throughout to be as unwholesome as the curiosity of the ladies and gentlemen to whom these lectures were addressed. A purely miscellaneous collection of psychic aberrations of this highly imitative and contagious type, not explained but merely depicted, is perhaps less vicious than public exhibitions of hypnotic phenomena, but can serve no useful end, and could not absorb the energies of a mind of scientific type intent upon their scientific elucidation.

Animal Magnetism. ALFRED BINET and CHARLES FÉRÉ. London, 1887, 378 pp. International Scientific Series, Vol. LX.

This is the only work in English that attempts a systematic presentation of the results of the study of hypnotism which has been carried on so assiduously for the past eight years or more by physicians, physiologists, neurologists, alienists and jurists, etc., in France. The subject is full of both scientific and practical interest, and we commend this book to physicians and students of psychology of all

schools. One French physician declares that hypnotism has already contributed results as important for the scientific knowledge of disease as bacteriology, and is likely to be even more practical in the treatment of a large and, in our age, a rapidly increasing class of maladies. Another asserts that somnambulic hyperaesthesia and mental exaltation supply the experimental psychologist with an instrument likely to prove as important for clinical medicine as the invention of the microscope for the pathologist.

This work opens with an historical sketch of the subject from Mesmer and Braid to Liebeault and Heidenhein. Those who have the hypnotic neurosis may be hypnotized, at least after more or less education if not at first, by the noise of crumpling paper, the tick of a watch, the beat of a gong, the odor of musk, a bright light, looking at not only a button but at their sewing, by a fixed attitude as of prayer, and by gazing in the mirror, contact, even accidental, with a hypnogenous zone, by suggestion, which may act by causing an intense memory-image of fatigue, etc. Some, it is said, may be hypnotized, not only against their will but without their knowledge, or even asleep, or by the proximity of an unsuspected magnet. Touching a pre-designated object ; looking at an imaginary lamp ; the bark of a dog, or the advent of a time appointed days or even months before, may cause this state.

The symptoms of hypnotism must be studied by defining most carefully the physical states of the subjects, and also the processes employed, and by beginning with simple and physical as opposed to mental phenomena. Thus Charcot's famous three states or nosographic groups were formulated in 1882, and have been much further studied by his pupils. I. Lethargy. This is marked by muscular flaccidity, closed eyes, and dull senses. Localized contractures are caused by pressing muscles, or excitement by touch, magnet or faradic current in nerves or tendons which persist in the limbs but not in the face. Three characteristic attitudes of the hand, caused thus by different local stimulus (ulnar, median and radial), are distinguished. If the limb is restrained from contracting upon such stimulus, the antagonist muscles soon act. These local effects are said to be transferred to the corresponding part of the other symmetrical median half of the body by a magnet, and by arresting circulation in the stimulated limb the contracture is made "latent" and appears as an after-effect of the stimulus when the ligature is first removed. II. The cataleptic or fascinated state, of a waxy flexibility, without tendon reflex, or neuro-muscular hyper-excitability. The extended limb does not tremble as it does if held in position by the will. The face takes on the expression of the same sentiment expressed by the attitude into which the limbs are placed. III. The somnambulic state is the most complex, and is marked by hyper-sensitiveness whether to sensations or to suggestions. The slightest touch or breath often causes muscular contraction, of less local character than that resulting from the much stronger stimuli exciting contracture in lethargy. In somnambulism the various hyper-excitable spots or zones—erogenic, reflexogenic, dynamogenic, hypnogenic, hysterogenic—are best studied. The magnet may change the rapport of elective somnambulism into hate. Thus it is claimed that using only strongly hysterical subjects, the existence of three clearly demarcated experimental nervous states is established.

This fundamental study of physical characteristics distinguishes the conclusions of the Paris investigators from those of Bernheim

and his school at Nancy, who do not find the muscular effects constant, and thus do not recognize the first two of the above states as distinctive, doubt the influence of the magnet, and believe all hypnotic phenomena due to suggestion. All, however, admit that suggestion may reproduce and magnify every fact of mental life, the dominion of suggested ideas being due to their increased intensity caused by psychical hyper-excitability. In the study of suggestion, simulation and unconscious suggestion must be rigorously excluded. The exploration of its effects has but just begun, for in a fit subject it seems able to produce all the actions possible for the nervous system, and what are the limits of what the nervous system can do is at present unknown. Focachon caused vesication by suggestion with the aid of a plaster made of postage stamps in twenty-four hours, the patient being watched and the blister photographed. Epistaxis and even blood sweats are thus produced. Any part of the body of an hysterical patient is proven by Mosso's process to change in volume, as *e. g.* a limb, by fixing the attention on it. Commonly ideas are secondary products; they are resultants developed from below upward. Suggested processes, conversely, are epi-phenomena; they begin in the centres of ideation and are developed to lower planes. This makes facts like the above and psychical paralysis entirely inexplicable on the theories of any of the existing psychological schools. In the hallucinations of hypnotism, subjects can add imaginary figures; receive wounds which they see, feel and dress; clasp imaginary objects; be transformed to a dog, a piece of glass; see correct mixtures, contrasts, and after-images of imaginary colors, of imaginary objects that are doubled if one eye is pressed, or a prism placed before one, and that are magnified by seeing them through an imaginary opera glass or microscope. Hallucinatory portraits are seen on blank cards, or on cards already photographed with entirely different faces. In viewing imaginary objects, convergence and pupillary aperture vary correctly with their changing distance. Sometimes these hallucinations persist in a waking state and are believed. Any commanded act whatever, though with varying degrees of resistance, is done, criminal though it be. Paralysis, which may be complete for a single limb or for all the muscles on one side of the body, can be caused by suggestion, and this is usually attended by an anaesthesia so complete that the subject really loses the limb, and must find it by searching with the eyes or other hand. Aboulia for a single act may be caused while all others can be done. He is unable *e. g.* to write the word *not*, while he can write all three letters in other combinations. Even this is said to be attended with reduced muscular power in the hand as tested by the dynamometer. The phenomena of the transfer of motor or sensory disturbances from one bilateral half of the body to the other, are described, and the work closes with a brief statement of the forensic and therapeutic aspects of hypnotism.

The book is a very useful and timely one, but is quite diffusely written. We should far rather have had a treatise written by a representative of the Nancy school of hypnotism, with less stress laid on the agency of magnets and action at a distance. The standpoint of these authors is but half scientific. This, we think, will become plain in the further discussion of the subject in this journal.

De la suggestion mentale. Dr. J. OCHOROWICZ. Paris, 1887, 541 pp.

This work is by an ex-professor of psychology and philosophy in the University of Lemberg. Its chief purpose is stated in a brief preface by Ch. Richet to be to prove that, outside of all phenomena appreciable by our normal perceptive powers, however acute, there exists between the thought of two persons a correlation that chance cannot explain, and its leading motto is Arago's sentence, that whoever, outside the sphere of mathematics, pronounces the word *impossible*, is lacking in prudence, for the limits of the possible are ever widening. The first part (five chapters) of the book is devoted to the author's observations. Suggestion to blindfold subjects by slight noises like the rustle of silk, the suggestive noise of Barèty's cuffs as he "projected the fluid" to one of his subjects, etc., by which hidden gestures are imitated and persons distinguished, the explanation of Charcot's stages, especially catalepsy, as "ideo-organic association" formed by hypnotic education, the criticism of tests for catalepsy (which consist commonly in lifting the arm which remains elevated in that state and otherwise falls, as existing or not as it is suggested or not by the motion of the lifting hand, which differs if the arm is expected to fall, from what it is if it is expected to remain), his insights that while pressure on the vertex causes religious ecstasy in Manchester, lethargy at Breslau, and somnambulism at Paris, it is suggestion in each of these centres of research that is the real cause, and that every thought having spacial reference tends to provoke unconscious but suggestive movements, his study and explanation of "Cumberlandism," or muscle-reading, by this principle which he termed in a former paper ideo-plasticity, and by which he literally found a needle a lady had hidden in a hay-mow, his recognition of the high hypnotic-pedagogic significance of even a very few seances in creating habitual reactions, and that thus polarities and aesthesiogenic points are developed—all these and many other criticisms of the author's observations on his own subjects and those of others in the many cities he had visited in quest of light in this dark field, indicate a cautious and critical mind, favored, as he remarks, by his early bent toward positivism. In the second chapter, mental suggestion, however, had grown from apparent to probable, and in the third it becomes "genuine." This last stage of conviction, we are told, was attained a year before publication, although he had studied and experimented since 1867. Although he has passed from the first skeptic stage of Gorgias where it is impossible to know the truth, it is only to realize that, being known, it is wellnigh impossible to state it, at least in terms consonant with the clumsy theory of association, and still less in the pretentious philosophical volapük of Kant and Hegel. The romance of the "elegant and intrepid" Hartmann gives us a better principle in the unconscious which is the real prestidigitateur, although so poorly defined. *True* mental suggestion Ochorowicz at last found with "Mme. M., aet. 27, strong, well made, and apparently in perfect health," but with all sorts of extreme hysterical symptoms, a vicious heredity, hysterogenic and delirogenic points, etc. Putting her in the "aïdeique," and then in the somnambulic state, and sitting out of her field of vision, he willed the order, "lift your right hand." At the end of the third minute and after much "agitation," although he is sure she could not have seen him, she lifted the left

hand. Other willed orders (rise, come to me, give me the bracelet, the hand, etc.) were executed with different degrees of fidelity. Hence he was led to his theory of the three states, aïdeique, monoïdeique, and polyaïdeique, active and passive, and that the true instant of mental suggestion is when the aïdeique state passes into passive monoideism. Being now essentially convinced of true mental telepathy or suggestion independent of action through the ordinary channels of sense, the author was visited by Mr. Myers, of the London Society for Psychic Research, and himself visited Havre, Paris and other places, still troubled by his doubts which frequent failures kept alive, but on the whole more and more convinced that sensations and ideas could travel through space as well as be transferred to a foetus. Heredity, in fact, may be conceived as unconscious mental suggestion. Mental may even succeed where verbal suggestion fails.

Part second is devoted to facts observed by others, which are classified as, first, transmission by organic sympathy from the surface of the body; second, sympathism and contagion, by touching in particular parts or moving the hands over the body in a particular way. In this latter chapter is a very interesting résumé of facts from many sources, on the different odors emanating from different parts of the body, and from the body as a whole in different emotional and hygienic states. The large body of facts now collected by Monin, and the experiments of Adamkiewicz and others, make it probable that not only quite localized sweats, but other osphresiologic anomalies are more general than has been thought. Even professions and vocations, as well as some diseases, seem to have often characteristic smells; so that disease, etc., "does not cease at the surface of the body." All such facts favor the fluidists. Yet "physical contagion has no interest," but only nervous contagion, which may be psychic, or physico-magnetic. A molecular equilibrium tends to be established between all bodies which approach each other. Motor states as well as pains may be transmitted, prejudice is not invented, but stimulated telepathically, as the author thinks the English society have shown. The same is the case with ideas and will. Not "[illegible]" but the unconscious of perhaps a "second order" is the seat of the mysterious inoculation. Part three is devoted to theories, conclusions, and applications. Brain or sense exaltation attends true action at a distance. Finally, mental suggestion must be regenerated by positive science, and will then mark a "new epoch of renaissance," by "translating in clearer accents the mysterious echo of current verities."

This large volume is a valuable thesaurus of facts and opinions, superficially grouped, animated in the first part by a personal and almost confessional element, but contains not a few repetitions, is vague in just those points where clearness is essential to its theories, and is written with little conception of the nature of the unconscious so often appealed to. In the author's wrestlings with successive theoretic interpretations which have been so long and so serious, and in the confidences to which he invites us, we behold a mind with a passion for candor so uncontrollable, and with a habit of hovering on the sharp edge of indecision so inveterate, that one is incessantly drawn away from the subject to interest in the author. We are sure his chief mistake is in believing that his so recently adopted conclusion of a purely mental suggestion is really the final outcome of his own studies in his own mind.

Le magnétisme animal etudié sous le nom de force neurique rayonnante et circulante. Dr. A. BARÉTY. Paris, 1887, 662 pp.

This is not only the largest but perhaps the most systematic, so far as tabulations, full definitions of terms in a glossary, an index of over thirty pages, etc., can go, of all the French treatises thus far produced in this field. It contains eighty-two illustrations. Dr. Barety squarely assumes in the preface that he has to do not with hypnotism, Braidism, or suggestion, but with a force within the human body that can pass its limits and influence other bodies, and can be stored up in fluid and solid substances. This force is seated or developed in the nervous system, is called neuricity or neural force, and may be static or dynamic. If the latter, it circulates along the nerve fibres and also diffuses or irradiates outward. Irradiation of this force may be ocular, digital, or pneumic. Of its many properties, those which act on living substances are called physiological. This force is propagated rapidly, along straight lines, may be reflected like light, and even refracted in a neural spectrum. It passes through many bodies and through some colors, the latter being thus distinguished as dianeuric and aneuric. Yellow paper, and complementary yellow, *e. g.*, completely intercept ocular and digital but not pneumic neuricity, but loses its aneuric properties if wet with a solution of quinine. Water is completely aneuric, but can be charged with neuric force. The different methods of neurization by contact, at a distance, by reflection, etc., are described. Fixed digital radiation can cause anaesthesia, hyperaesthesia, contraction, sleep general or of individual senses. Mobile digital radiations or passes, if in the direction of nerves, cause anaesthesia and contractions; if in the opposite direction, hyperaesthesia and muscular relaxation. Thus the direction in which the nerves pass or are distributed to the skin is basal for the determination of zones. Anaesthesic passes, *e. g.*, each side the nose must be downward, on the forehead upward, on the cheeks they must follow the facial nerve forward, must ray out in all directions from the superficial cervical plexus. If passes are from the forehead directly over the top of the head down to the neck, anaesthesia is caused in the front and hyperaesthesia in the back of the scalp, where nerves are distributed upward. The face is thus divided by a number of zones, lines delineating the "part" in the direction of nerves. On the inside of the arms, upward passes cause anaesthesia; on the outside, hyperaesthesia. Light passes down the back and up the face of the fingers cause flexion and insensibility; in the opposite direction, hyperaesthesia and extension, and so on for the rest of the body, the eye being often quite as effective, and all this part of the subject being copiously illustrated. Blowing is more irradiated across boundary or zone lines, is more subject to transfer, and can exalt the sensibility of eyes and ears. In contact between the magnetizer and his subject, the latter is made anaesthesic if the nerves of the parts in contact are distributed in the same direction; hyperaesthesic if in opposite directions. Liquids and solids may be neurized by blowing, by touch, and sometimes by the eyes, and thus become condensors or accumulaters, or magazines of one or more of these three species of force. Opposite parts of these substances, however small, may be neuralized in opposite senses. A square bit of paper breathed upon causes joy if applied anteriorly to the body of a good subject, and sadness if applied posteriorly. With subjects previously rendered anaesthesic, dorsal rays of force passed

through a prism cause sadness if they impinge on the dorsal side of the subject's hand, and happiness if on the palmar side, and conversely of palmar rays, with a region of indifferent rays between. The force was later found to be conducted along the hair of the subject; through the body of a third person, unilateral phenomena were developed, new points of contact for exciting partial waking in sleep, or other specific reactions were discovered.

We have no further space to detail the maze of discoveries of laws and deductions, all derived from the study of one hysterical girl of eighteen. The last part of the book describes very briefly, and with little attempt to confirm the above results, eleven other cases of patients who showed some of the more common phenomena of hypnotism. Quite apart from all question of the validity of all these theories, they have a suggestiveness of their own as a joint product of pseudo-scientific methods gradually evolving a set of systematized symptom-reactions in an interesting hysterical subject, half whimsical originations, half subtle divination of theories of the experimenter almost before they are known to himself.

Découverté de la polarité humaine. Dr. Chazasain. Paris, 1886, 29 pp.

The positive pole of a magnet, when applied to the external side of the hand or arm, foot or leg, and on the left side of the trunk and head, causes contracture, as also does the negative pole if applied to the inner side of the limbs and the right side of the body. Resolution of contractures is produced by converse applications, viz. the positive pole to the inside of the limbs and right side of the trunk. This is all duly shown by diagrams. The + and — electrodes from a constant current produce the same effects. These effects are all transposed in left-handed subjects. The so-called laws for the separate fingers and their parts are too complex for statement here. If one person touches a part of like polarity of another person, such "isonomic" contact causes contracture, while "heteronomic" contact is decontractive. Isonomic contact is also anaesthesic and reduces muscular energy; heteronomic is hyperaesthesic and increases it, and polarizing action is in general hypnogenic. Extending the hand heteronomally attracts a subject "as by an irresistible force," while isonomic positions repel. The law of transfer is derived from that of polarity, which is common to animals and plants, all being bipolar, while minerals are unipolar.

For those impressed by such conclusions it would be interesting to know how this author reconciles his conclusions with the very diverse but no less remarkable laws of Barety.

La suggestion mentale, et l'action à distance des substances toxiques et médicamenteuses. Docteurs H. Bourru et P. Burot, professeurs à l'École de Médecine de Rochefort. Paris, 1887, 308 pp.

The studies here reported began in 1885, with a young man who was subject to violent attacks of hysteria. The other principal subject was a young woman. It was found that non-volatile substances placed in the hand or behind the neck of these subjects produced characteristic effects, markedly distinct, rapid and intense. In some later cases the following suggestions of Richet were observed: 1. The operator did not know what the substance was which he held either in a tightly sealed bottle or wrapped in paper, either in con-

tact with or near the subject. 2. He diagnosed from the symptoms whether it was tetanizing or emetic, morphine or water, which latter had no effect, and the problem was whether pure chance which would make one in four of these reactions right was improved upon. The results are said to have been obtained when the substances were applied while the attention of the patient was diverted and without the possibility of his knowledge. Other physicians, Dumontpellier, Thomas and Pascal in Toulon, Dècle, Chazasain and Dufour, and an officer Rochas, have announced analogous results of their own observations, which are, however, less extended than those of Bourru and Burot. The substances experimented with, besides the metals used in the metallo-therapeutic tests at first made, may be thus grouped: 1. Narcotics (opium, morphine, chloral, hashisch, atropin, narcein, codein, thebain, narcotin); 2. Emetics (apomorphin, ipecacuanha, tartarus stibiatus); 3. Purgatives; 4. Alcohols; 5. Antispasmodics (especially valerian and camphor); 6. Anaesthetics; 7. Excitants (phosphorus, nux vomica, cantharides, jaborandi and pilocarpin). Even within these seven classes the different substances often produced well differentiated symptoms, which are illustrated by ten photographs. A grave difficulty of interpreting principal from accessory symptoms is admitted, or, as we should prefer to infer from the data, the special from the general symptoms. The alcoholic symptoms seem to be most marked and most differentiated according to the form in which alcohol was used. Besides these effects, gold and mercury, the latter when hermetically sealed in a tube, produced striking effects, but with most substances sealing the glass destroys the effect. The time of application needful for generating the symptoms; the after action after the stimulus is removed, which may cease at once or may last several days; the ratio in which increasing the strength of the substance or uncovering it increases, as it confessedly does, the effects; the phenomena of physiological antagonism—all these points are left very undetermined. These facts may be called experimental determinations, and the substances act in some way by disrupting for a time the equilibrium of the nervous system.

The second part of the book is devoted to explanation of the facts. Suggestion, whether by way of expectant attention, mental, or autosuggestion, is rejected. If there be suggestion it must be without words or gestures, and even without thought; and as the former consists in the transmission of psychic states inappreciable to the normal perspicacity or senses, the transfer cannot pass through the medium of intelligence.

Metaloscopic phenomena are most analogous to those here described. In fact it is concluded that the action of metals, woods, magnets and currents of electricity, and that of medicaments at a distance, are phenomena of one and the same order. A cut illustrates the alleged magnetic attraction of the fingers extended towards the side of his head upon the body of the patient. Even Barety's theory of irradiating neural force is approvingly stated. Magnetic force is the term best adapted to explain the facts. These discoveries can be applied in making a physiological analysis of medicines and persons, in testing, without danger, the impressibility of individuals for substances, in codifying the hitherto empirical action of curative agents externally applied, and in opening up a new therapeutic method.

This work is the best presentation of its class of phenomena, and

is exceedingly well arranged and clearly written. The most striking of its many defects is, however, the failure to adequately appreciate the subtlety of the sense of smell, which in many experiments, some of which have been described in this journal, is shown to be sometimes, even in the normal subject, almost incredible.

Les emotions chez les sujets en étât d'hypnotisme. H. LUYS. Paris, 1888, 106 pp.

This well known, somewhat speculative but reputable neurologist has also fallen to experimenting with a hystero-epileptic woman, 20 years of age, named Esther, of whom he publishes 24 instantaneous photographs illustrating her emotional reactions to 87 different substances—mostly drugs—at different distances. This subject had been a dancer and singer, was of an eminently theatrical temper, and was possessed of "a richly furnished imagination," her "exquisite sensory apparatus" was set in action by infinitesimal vibrations. The effects produced by the different drugs were emotional. Each substance disturbed the equilibrium of the entire nervous system, so that each emotional fibre when set in vibration by the different drugs produced expressions and attitudes of fear, disgust, jollity, tenderness and passion. Even trophic effects were obtained, but not specifically studied. The emotional effects vary much with the distance of the substance, also with the motion of the flask containing the substance over or even near the skin, and still more as it is applied to the right or left side. When we reflect, however, on the fact that the range and acuteness of the sense of smell is but little known, but that from what little is known it seems incredibly fine, that some drugs are known to owe their chief medical effect to smell, that in an hysterical organism everything is possible; that the expression of many of these photographs does not correspond to the known effects of the drugs—it is plain that the experiments of Luys were as inadequate in caution and number as his conclusions are hasty. Swelling of glands, turgescence of the face, exophthalmia, respiratory and cardiac modification, nausea, etc., are also produced and interpreted as accessory emotional effects. If the tube in which the substances were placed is empty, the reactions of the subject are interpreted now as after effects of a previous substance, now as reactions *per contra*, now as a chemical effect due to the substance of the glass itself, now as caused by air currents or coolness in approximating the glass, etc. Surely by such tests on such a subject an experimenter can prove anything, fantastic or hysterical caprice though it be. There is a ludicrous element brought out in these photographs that is irresistible. The author approximates a tube containing essence of thyme to Esther's neck on the right and her face expresses terror. When the same substance is brought around to the left of the neck she looks happy and contented. If applied to her finger it itches and Esther is depicted in the act of searching for an imaginary louse. Ipecac shows Esther about to vomit. Cognac thus applied is said to have caused the attitude photographed as Esther drunk. Water causes a scowl called hydrophobia. Under the action of valerian she is depicted as scratching gravel with her hands, while in no less than six of these photographs, interpreted as illustrating six different emotions, Esther's chief expression is exophthalmic.

Der moderne Hypnotismus, ein kritisches Essay. Prof. SEELIGMÜLLER. Deutsche Med. Wochenschr., Jan. 5 and 12, 1888.

These articles constitute the beginning of a series as yet incomplete. The first is chiefly occupied with an account of the work of Bourru and Burot (reported above). The second shows that the experiments with drugs at a distance (which were sometimes applied without wrapper, sometimes in paper, in open, now in closed, now in corked tubes stopped with various waxes, gums, etc., and now hermetically sealed), were more quickly and intensely successful the less the substance tested was closed. The greater the dose, the greater the effect. At first no difference was made between odorous and non-odorous substances. With some subjects it is, with others it is not, important to which part of the body the application is made. There seems to be no education, and the first experiments are usually best. The precautions are shown to be often ridiculously inadequate. Ether is said to cause fascination, for a very intelligent lady who had experienced it assured the Rochefort sages that this was the case, etc. The conclusion here reached respecting nearly all the experiments on the action of drugs at a distance is that they have been made "with an ignorance, a prejudice, and a lack of common sense unprecedented in the history of modern medicine." If an experiment does not succeed, it is a new and unexpected effect, revealing, perhaps, a hitherto unknown property of the drug, or some other new explanation is at once proffered.

De la suggestion, et de ses applications à la thérapeutique. H. BERNHEIM, professeur à la Faculté de Médecine de Nancy. Deuzième édition. Paris, 1888, 596 pp.

This we regard as on the whole the most scientific of the many works that have appeared in France within the present decade upon this subject, and we deem it a matter of serious regret that writers representing this method and standpoint were not chosen by the publishers of the International Scientific Series to present the subject to English and American writers, in preference to such thoroughgoing partisans of the school of Charcot, which, after its great service in giving a memorable impulse to studies in this field by introducing a new ideal of scientific method, has been latterly so reluctant to accept the far better methods and results of Nancy, that discredit, not only for the Paris school but for this field, is imminent. The study of hypnotic phenomena at Nancy, which, began on the present lines by Liebeault, a student hardly less diligent and sagacious than Braid himself, and who had the advantage of coming after that investigator, has led to very different conclusions respecting hypnotism from those reached at Paris or Toulon. The school of Nancy believes that the so-called physical phenomena of hypnotism, including those of Charcot's three states, are purely psychic, that hypnotic sleep is the same as natural sleep, and that in the latter the same phenomena can be obtained as in hypnosis artificially induced in the same subjects, even catalepsy, hallucinations, transfer, contracture, and automatic movements, etc., all appearing on suggestion ; that hallucinations are only suggested dreams, and dreams are only spontaneous hallucinations ; that without suggestion hypnotic subjects remain torpid and inert, and really in natural slumber ; that hypnotism is therefore not pathologic and has no necessary affinity with hysteria ; that hys-

terical phenomena are often developed either spontaneously from the too common association with magnetism and hysterical manifestations in the subject's mind, or else suggested more or less unconsciously by this association in the mind of the operator; that no one can be hypnotized unless he has the idea he is to be, so that the sleep itself is an effect of suggestion, and, like all its phenomena whatever, is due not to magnetic or any fluidic influence, or to any physical stimulus or manipulation, but solely to psychic impressions. Experiments where the conditions have rigidly excluded suggestion have not succeeded at Nancy. Bernheim has tried "with hundreds of subjects" to produce transference of thought without suggestion, such as Gibert of Havre, Mr. Myers of London, Perronnet, Ochorowicz, Janet and others in France, think they have obtained, but in vain. These phenomena and the action of drugs at a distance, if they be real, are facts of an entirely different order from those obtainable here. Bernheim believes that suggestibility exists in the normal waking state, but that it is neutralized or repressed by reason, attention and judgment. In sleep these faculties are enfeebled, impressions are accepted without control and transformed into movements and images. This psychic modality or new consciousness makes the brain more docile and plastic to suggestion, and more apt to react on the functions and organs either by inhibition or dynamogenesis. It is this aptitude, exalted by suggestion, that is effectively utilized for therapeutic ends. The supposed action of drugs at a distance is thus explained. The subject concentrates all his disposable nervous energy upon organs on which attention is focused to divine, with extremely hyperaesthesic sense, what the experimenters wish to obtain. Knowing that they are to get the effects of a substance in a sealed bottle, they begin with vague symptoms, like malaise, anxiety, agitation, nausea, which are effects common to most poisons—alcohol, opium, emetic, valerian, etc.

If among those present knowing the substance some one is struck by the first manifestations and translates their sentiments into words, the cue is instantly seized. If there are no words, then the physiognomy, gestures, the least index of approval or disapproval, are eagerly sought and divined with amazing acuteness; and if all these are absent, and even no one, not even the experimenter, knows, and all subtle odors are effectually eliminated, the experiment fails. Upon this conception of the nature of these phenomena, it is said therapeutics is best able to utilize what is claimed as one of the most important conquests of contemporary medical science.

Bernheim tells a new subject that he or she is to be put to simple normal sleep. It is well if the subject has first seen others hypnotized to see how simple and perhaps helpful it may be. He uses the command "sleep" after describing to them optical symptoms of sleep which he assures them they feel; but if they do not sleep, they are assured that sleep is not needful for hypnotic effects. Some subjects fixate first and then the eyes close, or are closed by the operator, and thus the image or suggestion of sleep is insinuated into the brain. Passes, fixation, etc., are not absolutely necessary, but serve only to concentrate the attention. The operator continues to say in ever lower tones, "You feel heaviness in the eyes and torpor in the limbs, the nervous system grows calm, sleep is coming," etc. With others a more brusque, authoritative method must be employed; with others the idea of being chloroformed was effective, or a few sniffs of chloroform, alone quite ineffective, cause sleep with the aid

of suggestion. It is not neuropathic or hysteric persons who make the best subjects or who are less apt to react by contra-suggestion, but those accustomed to obey passively. In place of the six theoretic stages of hypnotism by Liebeault, beginning with heaviness of the eyelids, and ending with perfect somnambulic response to the operator's will, Bernheim makes nine stages, divisible into two groups. In the first stage all signs of sleep are uncertain, but there is a nervous calm in which sensations of heat can be provoked by suggestion in different parts of the body, and certain pains can be destroyed and therapeutic effects secured. Hypnotism is defined as "the provocation of a particular psychic state in which suggestibility is augmented." This state need not necessarily be sleep, for catalepsy, anaesthesia, paralysis, and hallucination can be provoked without sleep. The highest degree of hypnotism is marked by amnesia on awakening, and by the possibility of hallucinations both hypnotic and posthypnotic. The term negative hallucination, applied to cases *e. g.* where objects within the field of view become invisible by suggestion, signifies that objects perceived are neutralized by the imagination, and not as the Paris school conceives, that perception is inhibited. Hypnotic achromotopsia and amaurosis are purely psychic. The modifications of circulation and respiration which characterize hypnotism are said to be due to emotions. The phenomena of instantaneous hemorrhage on any part of the body obtained by Dr. Mabille, and by Bourru and Burot, which resemble the self-suggested stigmata of Louise Lateau, which succeed only with the most rare subjects, and which Bernheim cannot produce, must be grouped with blushing, secretions, flushes, etc., under influences as truly psychic as the effects ascribed to magnets. Transfer and many other phenomena can be produced in the waking state by suggestion, and illustrate the same order of facts as Braid described in 1846 in his pamphlet entitled *The Power of the Mind Over the Body*. Suggestion without hypnotism may also account for the insensibility to torture, caused by ecstasy in the case of martyrs and victims of the Inquisition. The Nancy school has not been able to verify either the somatic or psychic symptoms of the three stages of Charcot, but manifests the signs of somnambulism, catalepsy, or lethargy at suggestion without rubbing the vertex, opening the eyes, beating a gong, touching or blowing on the skin, etc. In fact these processes have no effect of themselves. This is the conclusion also of all the experimenters of Nancy, and even of Liebeault, who during the last twenty-five years has hypnotized more than 6000 persons. The Salpêtrière subjects, besides being all hysterical, have been a long time in the hospital, and have come to reflect a false theory, the joint product of doctors and patients. Thus the manipulations of a special culture which unintentionally suggest reactions conformable to the theory, imitative of typical reflexes in other patients, have developed in this environment a species of hypnotism that is unnatural. Again, severe hysteria (the Paris theories rest on not more than twelve cases) is very rare compared with the very many common cases on which the Nancy conception of hysteria is based. Nothing, says Bernheim, is more curious than the errors of Binnet and Féré in supposing that they could rely on alleged symptoms of lethargy and catalepsy to eliminate the suggestion (the true key here also) in their experiments of transfer with the magnet. These subjects are probably not, as they think, oblivious of external influences. In lethargy *e. g.* the subject is impressed with the idea that he cannot or must not react to any stimulus or suggestion, and this state can be excited

artificially, as it were, in all patients in the somnambulistic state. In all the very many cases tried, Bernheim could never produce transfer of sensation, contractures, pains, etc., from one half of the body to the other with magnets without suggestion, but always did it with suggestion without magnets. The same is true of mixtures and complementary effects of imaginary colors, and the doubling of unreal objects by looking through a prism. The color effects are many and there is no doubling with subjects ignorant of these effects, but let them once see they are looking through a prism, or what are the effects of so doing, and what color or mixture effects occur with real images, thenceforth they exhibit all that Binnet and Féré found. Tests with rotating prisms show that the fictive image does not conform to the conditions of real images. Finally he recommends these young experimenters to repeat their experiments on new subjects with new precautions, and predicts they will reach very different conclusions. The tests of Bernheim are certainly far more varied and ingenious.

The chapter on history and literature is concise and full and is brought down to date, and is perhaps the best yet written in its space. The most important chapter is probably that on interpretation. Instead of being so unique and anti-physiological as this state at first seems (C. Bernard said if these facts were true they seemed to necessitate starting over again in physiology), it is largely explicable from the well known facts of reflex action, automatism, and instinct modified by the psychic organ. A man absorbed in thought is functionally decapitated, and like a frog deprived of its hemispheres, has the reflex and mechanical functions exalted. Changes of physiognomy, gestures, inflections, and all indications of emotional play, and perhaps walking, etc., all of which may accompany speech, are both more complex and much more regulated by laws than the conscious processes involved in discourse. When preoccupied we avoid obstacles, react to noises, odors, temperature, react to many incidental stimuli by acts which, though originally free, are so no longer. Intense impressions transform themselves into automatic acts; so, on the other hand, attention need not be long absent for hypnogogic illusions to arise. The faith of the theologians, or *credivité*, is abandonment to authoritative suggestion. It is indispensable for education, business, etc., and we have a first tendency to believe every statement, which credulity must be afterward corrected by a second, induced or native. This is akin to the cerebral docility which obeys all orders. The degrees of authority of the person who suggests, of sleepiness or concentration in the subject, and of native susceptibility, are of course many. Even the normal state presents "psychic decapitation" in a rudimentary degree. Ideas are projected or transformed as sensations.

Bernheim would explain suggestion to be carried out in waking states later, by assuming that impressions produced by artificial sleep, or provoked, are always conscious at the moment when they are produced. This consciousness, although lost on waking, can always be evoked by simple affirmation. These latent souvenirs may revive spontaneously in certain states of psychic concentration. Ideas suggested in sleep to be acted out later do not remain latent or unconscious till the moment appointed for action, as Beaunis and others have said, but may recur repeatedly in the interval. The last part of this book is devoted to the detailed description of 105 cases upon which the therapeutic effects of hypnotism have been tried at Nancy, nearly

all with success. These cases cover a great variety of complaints, mostly with nervous complications. Finally, all physicians are strongly advised to hypnotize no patient without his or her consent, to never do so save in the presence of a third person, and to suggest nothing not essential to therapeutic ends. These rules should be observed as safeguards of the physician's conscience and his professional honor.

Le somnambulisme provoqué, études physiologiques et psychologiques. H. BEAUNIS, professeur de physiologie à la Faculté de Médecine de Nancy. Paris, 1886, 250 pp.

This well known author introduces this work with a chapter of statistics of liability, showing that for the somnambulistic stages, concerning which tables by different observers have been most variable, the liability of the two sexes is about equal. Again, out of 744 hypnotic subjects, 23 were less than 7 years of age, and 59 were over 63 years old. That of the above total, 65 were between the ages of 7 and 14, and 87 between 14 and 21, is also significant for the possible role of hypnotization in education. Subjects were hypnotized with great care to avoid all muscular tension, and were told now that their heart beat more and more slowly, now faster and faster. The heart was made thus to vary between the extremes of 15.4 and 19.2 beats per second, the respiration rhythm remaining constant, all emotional excitement avoided, and the modification following almost immediately upon the suggestion. These observations, with facts like the famous Townsend case, that of Dr. Fothergill and the cases gathered by Tarchanoff, seem to show that in some subjects the will can act directly in retarding and perhaps accelerating the pulse, and suggest therapeutic effects, already found salutary in a few cases, in palpitation and other cardiac neuroses. Like Mabille, Dumontpallier and Focachon, Beaunis believes he has produced circumscribed cutaneous congestion, with local increase of temperature, passing to measurable swelling, and even vesication on the skin (generally of the forearm), by suggestion only. Dynamometric force in most cases (162 in 242) was reduced during provoked sleep. Hypnotic suggestion probably (the experiments are too few here to be conclusive) increases the acuteness of hearing, and reduces the reaction time for both tactile and auditory sensations.

In his interesting chapter on the nature of suggestion, and on spontaneity in the somnambulic state, the author shows himself in the main in accord with the other members of the school of Nancy. The theory of concentrated attention as represented by Braid, Carpenter, and Liebeault, is probably one of the most helpful phrases, but really explains little till we know more about what attention is. The conception of Durand de Gros (Dr. Philips) has the merit of trying to go deeper by suggesting that thought activity is reduced to its simple and isolated elements, so that mental action is suspended save at one point, while the nervous force accumulates to the point of congestion in the brain in general, and can be turned with unusually high pressure on to any organ or mode of action—this displacement by suggestion being termed ideo-plasticity. Beaunis says the primordial fact is the *action of arrest*, which may be either sudden cerebral shock, or gradual. In this state there is little or nothing in the mind which is not suggested immediately through the senses. The style of this book is clearness itself, and the material is well and conveniently grouped.

Du sommeil non naturel, et ses diverses formes. H. Barth. Paris, 1887, 186 pp.

This thesis contains a valuable bibliography upon hypnotism, which is treated as a proteiform malady of sleep, a common nervous diathesis. It is hereditary, a dynamic equivalent of convulsions in children, hysteria in adolescent girls, of neurasthenia generally, and perhaps of exophthalmic goitre, hypochondria, epilepsy, paralysis, which latter are often found in the ascendant. Pathological sleep may begin in an attack of simple noctambulism, consecutive to violent moral preoccupation, or in childhood in a cataleptic crisis resulting from worms, or later in ecstasy, lethargy, etc., but always must originate in a neuropathic basis. All the maladies of sleep can be artificially produced in hypnotism. A functional debility causes loss of harmony among the nervous faculties so that some centres react abnormally, either by inhibition or dynamogenesis. This dissociation of cerebral functions is greater than in normal sleep. Thus arise those paradoxical states which seem so extraordinary and mysterious. The physiological explanation of these purely nervous facts, which are strictly in accordance with scientific facts, should be far more widely diffused. The effort of Maury, Despine and others to trace certain resemblances between these states and those produced by certain narcotic and anaesthesic substances, with a view to inductions concerning the pathological physiology of morbid sleep, has not been successful.

Les anaesthesies hystériques des muqueuses et des organes des sens, et les zones hysterogènes des muqueuses. L. Lichtwitz. Paris, 1887, 182 pp.

The author, who dedicates his work to Professor Pitres, is an otologist and laryngologist, and his work is characterized by admirable diligence and scrupulous attention to details. The buccal mucous surfaces, the palate, nasal fossae, larynx, external meatus, tympanum and middle ear, conjunctiva and cornea, and finally organs of taste, smell and hearing were tested. The author finds that in hysterical subjects, anaesthesia of mucous surfaces almost always occurs with dermal anaesthesia, but was never observed to be completely unilateral over all the mucous surfaces. Tympanic sensibility plays no role in auditive orientation. The cartilaginous part of the eustachian tube seems never to be entirely anaesthesic. These tests were made by pressure, pricking and heat. The gustative field is often reduced. Parageusia is most common for sapid substances. Anosmia is more often unilateral, and although usually accompanied by anaesthesia of the adjacent mucous surfaces, seems less closely associated with dermal insensibility than is ageusia. Auditory anaesthesia has no rapport with that of the skin. Again, of eleven hysterical subjects, six had hysterogenic zones on the mucous surfaces. These seemed most common in the naso-pharyngeal region. Those with mucous also have dermal zones, and the former are often bilaterally symmetrical. Although ordinarily constant, these zones sometimes change their nature and appear and disappear quite suddenly. These points have not only high diagnostic significance, but their discovery is of great etiological and therapeutic value in such cases. By testing for such points, accidents in operations may be avoided. Chemical and elecrical agents often excite them.

Eléments de médecine suggestive. Dr. J. Fontan et Dr. Ch. Légard. Paris, 1887, 304 pp.

These two professors in the Medical College of Toulon agree substantially with the school of Bernheim—whose great work (above) they call a veritable catechism of suggestive medicine—in assuming that the hypnotic state creates no new functions, but only exaggerates the normal waking function of suggestibility, and hence we hear little of the action of magnets or of neuric forces, or of drugs at a distance. Hypnotism, however, differs, they believe, from normal sleep in that it fatigues, while the latter rests, and in certain ocular phenomena, especially palpebral and sometimes orbital spasms. Charcot's three stages are purely hysterical, but pure hypnotism is better differentiated by three degrees of intensity, with intermediate degrees which are described. Whether hypnotism is functional extinction of the ego, or essentially inhibitory, or a tonic cramp of the attention, loss of will, or hyper-excitation of cerebral cells by reflex changes of cortical circulation, or absence of associative functions, are questions as yet insoluble. It is said that a generation that has a passion for developing suggestibility is declining, but medical science would rob men only of the liberty to suffer. Hypnotization is no more dangerous than the ordinary methods of therapeutics. If hens have been killed by hypnotism, as appears, drugs would have been no less effective. With one apathetic patient with mild delusions, it was enough to suggest, "you will see no more apparitions and talk no more with the wall, will have no more thoughts of suicide, will practice your piano, learn your lessons, and you will will." Suggestion seems to act on every function under the influence of the brain. Painful sensations do not hurt if the idea of pain is not aroused. Suggestibility is reversion to a state which is infantile in being mainly automatic, plus such results of mature experience as have become mostly automatic, but always with irresistible impulsion, whether faintly conscious or not. Even moral orthopedics, at least so far as the correction of unhygienic habits are concerned, is practicable in some cases. It is far easier to inhibit and repress functions than to develop them. Part second of this volume teaches physicians how to apply these methods, and part third states results, followed by 89 cases of cure or great amelioration due to hypnotism, these cases constituting nearly two thirds of the entire volume, and may be thus tabulated :

A. Diseases of the nervous system. 1. Organic affections of the nervous system, apoplexy and consecutive hemiplegia, myelitis, meningitis—6 obs.; 2. Grave neuroses, hysteria, abortive or complete epilepsy—7 obs.; 3. Insanity, alcoholism, hysterical insanity, delirium, imbecility—5 obs.; 4. Palpitations, insomnia, lassitude or neuropathic troubles—8 obs.; 5. Neuralgias, sciatic pains, megrains, and other nervous pains—14 obs.

B. Other diseases. 1. Nervous, muscular, secretory and other troubles due to internal affections, whether hepatic, pelvic, rheumatic or gastro-intestinal—21 obs.; 2. Diseases due to external troubles, such as contusions, urethric inflammation, affections of joints or skin—21 obs.; 3. Fevers, paludism and pyrexias—4 obs.; 4. Chlorosis and menstruation troubles—3 obs.; 5. Surgical anaesthesia—4 obs.

Reflex and painful troubles seem chiefly amenable to this treatment in these cases, all from the practice of the authors in the maritime hospitals at Toulon. There are a few failures, but the ratio is not far from that of Liebeault in the hypnotic treatment of incon-

tinence of urine, viz., in 77 cases eight failures. It is always the suggestion and not the hypnotism that cures in this cerebral orthopedics. Voisin reports a case of mania and another of lypemania favorably modified by hypnotic suggestion, and later three cases of hysterical insanity. This method must henceforth take an honorable rank in therapeutics. Psychologists and alienists will be especially interested in cases VIII—XVI, both inclusive. The work as a whole is serious and purely practical, but we are less convinced of the efficacy of hypnotic suggestion in the class A 1 and in B throughout (above) than of A 2—5, where its efficacy seems well established.

L'hypnotisme et les états analogues au point de vue médico-légal. GILLES DE LA TOURETTE. 1887, 534 pp.

The author of this valuable work was lately an interne in the Salpêtrière, and is now lecturer on legal medicine, and is full of acknowledgments to Charcot and Brouardel. Liebeault reported in 1880 that out of 1014 persons tried, all but 27 were hypnotized. Many signs, such as ready perspiration, habits of unquiet sleep and of dreaming, anaemia, neurotic diathesis, especially hysteria, have been said to indicate those adapted to hypnosis. Of all the hypnotic states, lethargy is the state most favorable to rape, as shown by many criminal cases. Hypnotic education may be in the line of suggested movements, hallucinations, or of acts. Suggestion, which is best in the somnambulic state, becomes more and more irresistible, and the most outrageous crimes can be done by as well as upon the subject. Not only does resistance gradually grow impossible, but even memory of crimes both done or suffered is often irrecoverably lost on waking sometimes, especially if the suggestion that they be so forgotten is made. All this is the more alarming if acts can be suggested mentally without word or sign, as is so often claimed, but which the author deems not proven. Suggested amnesia may be partial and one may recall and perhaps confess a suggested crime and forget the suggestor. Retroactive suggestion may be made in such a way that the subject believes himself to remember acts or crimes committed, or robberies or outrages suffered, which have not occurred. A crime may be suggested to a hypnotized subject to be done hours, days, or even weeks in the future, and the subject then awakened. But at the appointed time the act is spontaneously done, and in some cases entirely forgotten. The problems what is the state of the subject in the interim between the suggestion and the act, and what at the time of the act, are as important for determining the question of responsibility as they are difficult to solve. Natural somnambulism is often one of the first symptoms of hysteria, and somnambulists make excellent hypnotic subjects. If, in the dissociation of senses thus caused, a somnambulist or hypnotic subject falls from a height and is killed, life insurance companies should not interpret it as suicide (which vitiates policies), for it was not intentional. Hypnotism is as valid an exculpation from criminal intent as insanity, although the former on account of its brief duration is more easily simulated. Yet if the subject knows his malady he may be culpable if he takes no precautions and crime is done. Somnambulism is a dream in action, as *e. g.*, in the case of a nun who dreamed the friar of the convent had slain her mother, rose in her sleep, found and stabbed him. These states are nearly always partial sleep, or sleep of the unused senses. Although the degrees of resistance to suggested acts vary greatly with

the subject, the state, the act, mode and force of suggestion, etc., resistance, at least in a subject often hypnotized, can be generally overcome, and even contradictory suggestion accepted with short interval and little objection. Suggestion may even be automatic or self-made. Most cases of supposed death and reanimation are cases of lethargic hypnotism. The second or induced state in cases of dual personality is generally prolonged hysterical somnambulism. Hypnotism is a most valuable agent in the treatment of hysteria in all its forms and complications, and even in hysterical insanity as well as paralyses and cramps. As an anaesthesic agent in surgical cases, despite the great success of Esdaile with 300 cases in the "mesmeric hospital" at Calcutta, and the many amputations, confinements, etc., its efficiency is demonstrated, but chloroform is preferable. "Suggestive medicine" illustrates the power of the imagination, teaches us how truly efficacious relicts and incantations have been, and should be applied with success in certain cases by regular practitioners. Hypnotism is also the best test or revealing agent of hysteria. With such temperaments extreme results may be reached at once, in some cases even suicide. For all crimes and accidents the hypnotizer should be held legally responsible.

One chapter is devoted to quack magnetizers and their advertisements, and argues that travelling exhibitors of the phenomena of hypnotism like Hansen and Donato should be restrained by law, and details many evils arising therefrom. The chief crime due to hypnotism that has thus far come before the law is rape; but as simulation is one of the most characteristic traits of hysteria, it is possible that these may be based on either false or suggested ideas. Finally, an addition to the French code punishing rape in unconscious states is demanded.

This work is on the whole the best thus far written on the forensic aspect of hypnotism. Its material, however, is arranged on no plan, and with very little method, and bears every mark of haste and immaturity.

Étude de la mémoire dans ses rapports avec le sommeil hypnotique. Dr. A. Dichas. Paris, 1887, 122 pp.

This thesis for the degree of Doctor of Medicine at Bordeaux is a brief systematic study of the phenomena of memory that appear in the hypnotic and post-hypnotic states. According to Dr. Dichas, a complete act of memory consists of three principal phases: 1. The reproduction of a previous state of consciousness, *i. e.* an illusion of memory; 2. the rectification of this illusion by a real state of consciousness; 3. the localization in the past. Of these, the first, which necessarily implies the registering and conserving of the original impressions, is the only essential one. In normal memory, "all reduces itself," in the words of M. Taine, "to the creation of an illusion which is immediately contradicted and rectified." In the hypnotic state, on the other hand, the recall of the image, or the illusion, alone occurs, not the rectification. In its place there is an hallucination which finds its explanation in the fact that the automaton alone acts in hypnosis. The author reports many interesting cases of hypnotic subjects observed at the hospital of St. André in Bordeaux. From the study of these and other cases he draws some interesting conclusions. The phenomena of double consciousness are not, as Ribot thinks, to be explained by supposing two memories existing

side by side—the first normal, long organized in the brain of the subject; the other temporary, parasitic, produced by the crisis and lasting only while it lasts. The explanation is rather to be found in the exaltation of the normal memory that occurs in the hypnotic state. Memory is so essential for intellectual activity that the increased power of reproducing impressions may well explain the altered character that the patient displays in the "second state." Dr. Dichas suggests also that, as the memory of the hallucinations of the hypnotic trance may persist in the normal state, while that of ordinary impressions as a rule does not, this fact may account for the numerous confessions by respectable women of incredible crimes reported in the books upon sorcery and witchcraft. The author summarizes his conclusions as follows: 1. During the hypnotic sleep the hypnotized subject remembers events of the waking state and events of previous hypnotic states. 2. In hypnosis, spontaneous or induced, there is often an exaltation of memory. This exaltation can profoundly modify the mind of the subject to such a degree that he no more recognizes himself, and believes in a doubling of his personality. 3. In the hypnotic state disorders, spontaneously or artificially produced, may profoundly modify the function of memory (*Amnésies provoquées, ecmnésie*). 4. After waking, the subject has generally lost the memory of what happened during the hypnotic sleep. But with some patients a simple association of ideas is sufficient to recall what is apparently forgotten. With some subjects, too, all is lost save the memory of hallucinations produced during the hypnotic sleep. This memory, by its persistence in the normal state, may cause serious trouble in the intelligence of the subject. 5. The forgetting of acts done in the hypnotic state is at the discretion of the experimenter, who by a simple suggestion can recall the partial or total memory of them. 6. Acts done in the normal state, or in the hypnotic state under the influence of a verbal suggestion given during the sleep, are subject to the same laws of memory as acts done during hypnosis that are not suggested, *i. e.* after they are performed they are forgotten when the subject is awake, and recalled to memory in subsequent hypnotic states. 7. Suggestion appears to be entirely a phenomenon of unconscious memory. 8. The study of memory, in its relations to hypnotism, enables one better to determine the responsibility of the hypnotic subject. Also, thanks to this study, one can better understand certain facts formerly deemed supernatural. W. H. B.

Sur la polarisation psychique dans la phase somnambulique de l'hypnotisme. BIANCHI and SOMMER. Rev. Philos., Feb. 1887.

The following new experiments still further illustrate what Binet and Féré first called psychic polarization. A pleasure trip on a railroad is suggested to a patient who can only with great difficulty be put in any but the somnambulic stage of hypnotism. On applying a magnet a centimeter from the back of the neck she becomes troubled and thinks of a railway disaster. Many other illustrations are given in which the emotional state and a corresponding image are reversed by a magnet. Emotional states in the somnambulic phase cause oscillations of the galvanometric needle, but this does not occur if the subject is wakened. With each impression the opposite is developed but not attended to. Attention views only one term of pairs of opposites so long as it follows logical or associative laws, but when these are

weakened, as in somnambulism, the opposite of each idea emerges, and thought drops to the stage of contrast or antithesis, and correlative ideas are no longer modified or co-ordinated as in the higher stages of normal life. A magnet even brings out in the somnambulic consciousness a complementary color.

L'anesthésie systématisée et la dissociation des phénomènes psychologiques. Pierre Janet. Rev. Philos., Mai, 1887.

After reporting an interesting series of experiments illustrating negative hallucination or systematized anaesthesia (where *e. g.* a subject in response to suggestions made in the hypnotic state is unable to see or do certain things on waking), such suggestibility is ascribed to a state of dissociation. Psychic phenomena may be conscious, but leave no trace in memory, because all ordinary associative traces are forgotten. When a subject is unable to see among a dozen cards in her lap all those marked with a cross, containing numbers which are a multiple of three, or certain persons, etc., as a result of hypnotic suggestion, it is not to be explained by assuming unconscious perception. The objects must in a sense be seen in order to be excluded, and it is an error to say that sensation is destroyed. Association springs up, moreover, between the objects thus tabooed from waking consciousness. What are the limits of this dissociation, how many aggregates of states may thus be formed, or better, what are the phenomena that are not thus subdivisible, cannot yet be told.

De la prétendue vielle somnambulique. Delboeuf. Rev. Philos., Feb. and March, 1887.

Invited by M. Charcot to see some of his more remarkable patients, and allowed to freely test them, M. Delboeuf reached the conclusion that the phenomena, though surprising, were not a tissue of mysteries, but that the mental faculties of subjects in the somnambulic state of sleep, on waking are depressed to the same degree as in normal sleep, and points out many analogies to states he had described in his well known work on sleep and dreams. The sleep walker is monotonous and plays only the tune he is wound up for, or hatches only the egg deposited in his brain by the suggester. Beaunis even says the subject proceeds to the prescribed end with the fatality of a falling stone, but thinks he is free. But yet if the act commanded is a little strange, while it is done all the same, the subject seeks reasons for doing it, and there are sometimes even traces of resistance, and the subject may even feel himself condemned, forced to an act. Beaunis concludes from hypnotic tests that the subjective conviction of freedom in these subjects does, and therefore in us may comport with perfect automatism. But, says Delboeuf, if we are not free we know nothing of the alternative between freedom and necessity. Rather the hypnotizer is free and responsible, and the subject who acts on his suggestion is not.

Das Wesen des Spiritismus vom physikalischen und physiologischen Standpunkte. Dr. Hermann Spiegel. Leipsic, 1888, 70 pp.

The "sympathetic system" is the organ of the "Gemüth." A "spiritist" is one who can excite his sensibility "reflexly from the centre," while common men can do so only from the periphery. He can excite his intellect at will, but not his "Gemüth," and "separates his sen-

sibility from his motility," whence his apparent clairvoyance, which increases as the functions of motion and will decline. This is about the same as occurs in sleep. Thus the spiritist is "an artist of the first rank who plays the role of either an amateur or of a sleeper." The pamphlet has no scientific value or method, but has the mild merit of attempting to turn attention from the realities and so-called facts of spiritualism, to seek the key to it all in the psycho-physiological processes of the "medium."

Le spiritisme. Dr. Paul Gibier. Paris, 1887, 398 pp.

This is a historical, critical and experimental study of "occidental fakirism," contains twenty-four cuts and a bibliography, and is devoted more to "experimental spiritualism" than to hypnotism. The author describes the researches of Crooks and Zoellner, raps, spontaneous writing, transportation of bodies without contact, in a way surely hardly worthy a professional naturalist, and concludes with an appeal for a society for investigating "this branch of physiological psychology." Allan, Kardec, Eliphas Levi, Houdin, the fourth dimension of space, cell and plastidute souls, theosophy, mysticism, ancient oracles and magic, comparative religions and theology are the chief centres of interest in this book, which thus illustrates how ineffective is the education which a man now receives in the young author's chosen field to fit him to study with true scientific spirit and method, phenomena in such a field as modern hypnotism opens.

Magnétisme et hypnotisme. Dr. A. Cullerre. 1887, 358 pp.

This work, here published in a second enlarged edition, contains twenty-eight figures, is a very comprehensive survey of the whole field, historical, psychological, clinical, legal, etc. It is written from no well defined standpoint, but modulates from illustrations of the Rochefort experimenters to the telepathic drawings of the English society for psychic research, and thence to the localization diagrams of Ferrier, with no clear method. The author is evidently a suburban middle-aged general practitioner who has read and quotes extensively.

Le nouvel hypnotisme. L. Moutin. Paris, 1887, 220 pp.

This illustrated book, though written by a public exhibitor of twelve years' experience, and of repute not unlike that of Hansen, Das and Donato, has a certain interest to the scientific student of hypnotism. The author is evidently frank in detailing the manipulations and other methods he has found successful with refractory subjects, and even in describing a list of accidents produced in vulnerable subjects by either submitting to or witnessing his hypnotic seances. His drastic methods, the symptoms he relies on, which all evince profound nervous disturbance, the kind of scenes he describes as most effective with audiences, all tend to show that despite the zeal displayed in propagating the cause of "true magnetism," which he says makes for health and science, public performances like his should be suppressed by law.

Der Hypnotismus, mit besonderer Berücksichtigung seiner klinischen und forensischen Bedeutung. Klinische Zeit- und Streitfragen, Band 1, Heft 2. Prof. Dr. HEINRICH OBERSTEINER. Wien, 1887.

This pamphlet presents, under the convenient captions, processes of hypnotization, sensory, motor, vegetative, psychic phenomena, suggestion, physiological explanation, therapeutic and forensic applications, a very concise account, by a well known physiological investigator, of the best results reached in this field by recent studies, and is especially addressed to practical physicians. It is by far the best in its space and ought to be translated into English and placed in the hands of every medical practitioner.

Der Hypnotismus in Frankreich. MAX DESSOIR. Sphinx, March, 1887, pp. 141–160.

This article describes briefly the literature upon the subject during the last few years, and contains the best general bibliography upon the subject yet made.

L'intensité des images mentales. A. BINET. Rev. Philos., May, 1887.

The world of images has its laws and its mechanism. Merely to indicate an idea by way of suggestion is not enough; it must be impressed. It must not only be introduced into the mind of the hypnotized subject, but must be reinforced along the various associative lines of force, for we exteriorize associations as well as single images. Most female subjects have a certain sexual attraction for the magnetizer which may be called "elective sensibility," or "experimental love." Suggestion is really suggestive of form but not color. The tone of voice, direct appeals to attention, increase psychic hyperexcitability and make images intense. Association by resemblance may be intense, and association by contiguity ignored, as *e. g.* in echolalia. Looking at a red disk intensifies the effect of feeble suggestion to hypnotics, making them effective and quickening the memory, and causing in a word the explosion of an idea or act suggested. Peripheral excitation thus corresponds to diffuse, and specific suggestion to localized excitation. So risk often stimulates premeditated crime by giving a stroke of the whip, as it were, to the imagination. Even pressing the eyebrows together, as in voluntary attention, causes psychic dynamogenesis, increases unconscious pressure on the dynamometer, and shortens reaction time. (Cf. Dr. Lombard's article in the November number of this journal on the knee-jerk.) Conversely, all contradictions enfeeble images, and may even expel them; so also does all resistance on the part of the subject, or a suggested image of paralysis. Separation of the eyebrows enfeebles movement and mental imagery. Paralysis may be suggested by association, as where hemiparesis is suggested and aphasia results with it, or where suggested paralysis of a word involves paralysis of the associated image.

Trance State in Inebriety. T. D. CROTHERS. Journal of Nervous and Mental Diseases, Sept. and Oct., 1886.

Dr. Crothers, who is probably the best authority in this country on the psychology of inebriety, adds in this article many interesting facts and inferences to his previous communication on this subject. Sudden partial loss of consciousness of variable duration he believes

to occur in the majority of cases of inebriety when there are no symptoms of intoxication. He may suddenly follow a line of conduct considered but abandoned before, and carry it on with vigor for days or weeks and then stop abruptly, indicating the close of the trance, and go on after with no reference to what he had done. Crimes are sometimes done in this state, with the most conclusive evidence of no memory of it whatever afterward. Even slight drinking often occasions blanks of memory so complete that others must inform the patient what has occurred. One wakes up, as it were, and finds himself in a Turkish bath with no idea of how he came there. This alternative state is perhaps best illustrated in periodic drinkers with long intervals between sprees. All inebriates are bad witnesses as to themselves or their surroundings. The problem of responsibility for crime in such cases is a large field for future study. The relation of these phenomena to epileptic trances, as *e. g.* of the kind lately described by Dr. Hammond to account for mysterious disappearances, and to cases of hypnotic trance, multiple personality, etc., is yet to be traced.

Ueber die therapeutische Verwendung der Hypnose. Dr. RICHARD SCHULZ. Neurologisches Centralblatt, Nov. 1887.

A grave case of hysterical paraplegia, of two years' duration, in a seventeen-year old peasant girl who had been unaffected by other methods of treatment, was almost entirely cured by a few weeks of hypnotic suggestion. This case was studied with indefatigable diligence, and the exact extent of dermal anaesthesia for different tactile stimuli was carefully determined, and its changes shown by convenient illustrations. The same care was also directed to the demarcation of retinal insensibility. The description of the gradual development of the hypnotic state and of its curative effects is interesting in itself, and is made still more so by the fact that Dr. Schulz is himself a good hypnotic subject and gives his own impressions of the subjective nature of the hypnotic state. He inclines to Heidenhain's opinion that the cause of this state is the inhibition of ganglion cells of the cortex, induced by faint but prolonged stimuli of the facial, auditory, or optic nerve. With his patient, he believes the psychic impression that he possessed some marvellous mystic power played the leading therapeutic role. The reason German physicians have been less eager to follow the lines of investigation opened by Charcot and his school at Paris, and by Bernheim, Liebeault and Beaunis of Nancy, is, he thinks, that electricity and the Weir-Mitchell and Playfair-Burkart modes of treatment have been so much more widely used in Germany than in France, and with such good results; but strongly dissents from an opinion expressed by a recent writer, that German medicine should maintain an attitude of coolness toward the entire problem of hypnotism.

Two interesting new cases of hystero-traumatic paralysis in men are reported from Charcot's clinique in *Le Progrès Médical* for Jan. 22, 1887. A waiter, aged twenty-nine, of neuropathic heredity and history, was bruised by a vehicle. He often repeated the details of the accident in the ensuing delirium, but quite differently from the real facts, which seemed to indicate forgetfulness of all that took place at the moment of the accident. He experienced intense cerebral commotion followed by

the traumatic retrograde amnesia of Ribot and Azam. There was increasing immobility of the limbs ; absolute anaesthesia of the pharynx such that the finger could be thrust to the epiglottis without the least reaction. Hearing was reduced and the field of vision was obscured concentrically in both eyes. The dermal anaesthesia extended over the entire surface of the lower limbs, save only the entire sole of the right and the anterior half of the sole of the left foot. This mode of limitation of anaesthesia is very different from that produced in organic lesions of the spinal cord, where the insensibility extends over the lower abdominal regions, and is marked off from the normal parts near the umbilicus by a line nearly perpendicular to the axis of the body. The delimitation rather corresponds quite closely, as is shown by plates, to that produced in hypnotized hemianaesthesic subjects when in the somnambulic stage paralysis is suggested on the normal side. The explanation for this case is therefore the following: At the instant of the accident the patient lost consciousness for several hours, and afterwards lay for several days in a state of torpor or obnubilation, propitious for the efficacy of suggestion. "Local shock" left the limbs weak, and the idea of paralysis was auto-suggested, which was aided to vividness by emotional perturbation. It is possible that the idea thus developed was that the limbs were crushed and even removed. *Schreck-lämungenen*, fear-pareses, and the sentiments of feebleness produced by strong emotions probably exhibit parts of the same mechanism or terms of the same series of not yet well ordered phenomena. If this explanation be correct, this case is an illustration of reflex unconscious cerebration where the centre of the diastaltic arc is that part of the cortex representing the centres of voluntary psychic movement, mental unity being thus easily dissociated, so that adjacent regions are unaffected. The fact that the paresis had suddenly vanished in a convulsive attack confirms diagnosis of hysteric symptoms, but the anaesthesia was not reduced.

The second case is that of an athletic man of twenty-five, of imaginative and moody temperament. After a slight contusion on the shoulder he conceived the idea that the entire right arm was removed and a heavy weight hung in its place. Sensibility was reduced in the field of special senses and over the entire dermal surface of the body. Although not hypnotizable, the state of suggestibility is developed by the cerebral disturbance produced by nervous shock.

Note sur l'écriture hystérique. A. BINET. Rev. Philosophique, Jan., 1887.

In the case of hypnotics who write, as they think, conformably to the character of the personality impressed upon them, it is possible that a mental model furnished by memory may have been copied. If so, these cases are of small use to the graphologist who seeks in writing the unconscious expression of character. M. Binet states it as a law that all sensory excitement produced by colors, a magnet, praise, etc., excite in hyperexcitable subjects a general dynamogenesis causing enlarged and often more rapid writing. The character of the sentiment written often instinctively enlarges the script, which in such subjects is soon reduced by fatigue to perhaps even less than its normal size. Excitation and depression are thus directly mirrored.

Ueber die Auto-suggestion bei den Hypnotisirten. N. CYBULSKI. Centralblatt f. Physiologie, No. 12.

Although cases in which hypnotic subjects can send themselves to sleep have been recorded, no special observation of the phenomenon has been made. The author observed that such subjects could hypnotize themselves at any time and entirely independently of the operator. For this purpose the subject has only to imagine for a minute or less that the operator commands him to sleep. The author, without the subject's knowledge, induced a third party (who had no influence on the subject) to propose to the hypnotic that he should imagine that a definite time after awakening he should perform a certain action or have a certain hallucination. Although the subject did not suspect that this proposal originated with the operator, he went through the suggestion in detail. Furthermore, if the subject imagines on going to sleep that he is in rapport with a certain person, even though hypnotized by his operator, he remains indifferent to the latter. From these observations the author concludes : (1). That the rapport between subject and operator is due simply to the fact that the former has the latter in mind when passing into the hypnotic state. (2). That all hypnogenic methods are at bottom only various devices for getting the subject to fix his attention upon a single concept. (3). These observations help to explain such phenomena as hypnotizing through the telephone and certain phases of so-called "telepathy." (4). That results are valid only if the subject in the waking condition had no knowledge of what it is proposed to do with him when hypnotized ; if he does know it, any result whatever can be obtained. This explains what has been ascribed to the action of the magnet, and so on. J. J.

Magnetismus und Hypnotismus. Eine Darstellung dieses Gebietes mit besonderer Berücksichtigung der Beziehungen zwischen den mineralischen Magnetismus und dem sogenannten thierischen Magnetismus oder Hypnotismus. G. GASSMANN. 218 pp.

This volume appears in a series of manuals forming an electrotechnical library, and the scientific character of its associations gives it a scientific appearance which it far from deserves. The material is indiscriminatingly collected from all sources ; an account of a strictly scientific experiment on one page and an utterly incredible sensational (alleged) fact on the next. While denying that the magnet can do all that the mediaeval sorcerers claimed for it, the author yet holds that its influence on the body is underestimated, and that it is "an incontrovertible fact that water undergoes some change by being magnetized with the hand."

The author has invented an improved "hypnoscope" or little magnet, to be applied to the finger, and by the sensations then aroused to furnish a criterion of the hypnotizability of the subject. Two thirds of about 500 persons who tried it experienced certain peculiar sensations, and many of these were more or less ready hypnotic subjects. But the many experiments in which magnets of the greatest strength have been used in such a way as to preclude the action of the subject's imagination, without getting the slightest result, are utterly ignored. In the same way no mention is made of the experiments that show that transfers can be obtained independently of the magnet. The author assumes as a proved fact what is a

matter of extreme doubt, viz. that the magnet has an influence on the human body. He is no less shy in accepting the truth of thought transference, and believes that very sensitive subjects can be made aphasic by looking at the left side of their heads.

The useful portion of the book consists of the historical notes (not always accurate, however; *e. g.*, it is said that Dr. Pigeaire really had a patient who earned the 3000 franc prize for clairvoyance, while the true and usual statement is that this subject refused to conform to the conditions of the Academy of Sciences); of the abstracts of some scientific papers, and the exceptionally numerous and admirable illustrations. In short, the book has an unfortunate pseudo-scientific air, and is much less reliable than some of the recent French compilations on the same subject. J. J.

Experiments in Improving the Condition of Deaf Mutes by Hypnotism. Dr. BERKHAN. Berlin. klin. Wochenschr., 7 Feb., 1887.

Nine boys in a deaf mute institution in Braunchsweig were hypnotized by gazing at a glass button, after their hearing had been carefully tested for a variety of noises. During the hypnosis vowels were spoken into the ears of the patients and other noises made, and they were aroused as soon as possible. The hearing of the boys was tested about half an hour later, and the process was repeated from four to six times on each boy with intervals of a week. The hearing of four of them has very greatly improved, though by no means restored, and at the time of the report the improvement had lasted about eighteen months.

De la suggestion et de ses applications à la pedagogie. Dr. BERILLON. Paris, 1888, 16 pp.

This is a continuation and reinforcement of the writer's paper on the same subject in 1886. The method of putting bad children to sleep so gradually as to awaken no opposition, and by purely verbal suggestion, is first stated. The nature of the suggestion is next discussed. This must be formulated with great precision, after a careful moral diagnosis, and often repeated in a voice and manner at once authoritative and sweet. This is an art of itself, and consists in condensing to laconic brevity the moral needs of the child, with a view also to ready realizability. The child must be alone and not subject to taunts of his fellows for being subjected to the process. A number of new cures of laziness, perverse instincts, grave defects of character, nervous tics, incontinence of urine both by day and by night, menstrual irregularities, chorea and irascibility, are narrated. Bernheim endorsed these conclusions at the end of the paper, and adds that the mother's means of putting her child to sleep are the original hypnotic methods.

Variations de la personnalité. Docteurs H. BOURRU et P. BUROT, professeurs a l'École de Médecine de Rochefort. Paris, 1888, 314 pp.

This book begins with a more detailed study of the case of V... Louis, of multiple personality fame, whose states have been described more briefly by Camuset, du Saulle, Richer, Voisin, Ribot, and F. W. A. Myers of the English society for psychic research. This subject was born in February, 1863, of an hysterical mother and an unknown

father. As a boy he was a vagabond and a thief, and since 1880 had filled a number of servile stations and been a patient in several hospitals, where his hysterical attacks attracted much attention. The six primary states or personalities of this subject are described, with the convenient table of Mr. Meyer showing for each state the extent of the subject's memory, his disposition and education, paralytic and anaesthesic symptoms, dynamism for both hands, etc. Other intermediate states, both spontaneous and provoked, are observed by these authors, who also observe perfect accord between the physical and attendant mental symptoms of each state, and tolerable accord between the successive personations of the same role so far as could be gathered. Each of these states and others are shown by photograph. The last half of the book is occupied by accounts conveniently compiled from many sources of other of the more important subjects of these changes. An abstract of explanatory theories is given in the last chapter, and the authors themselves explain these changes by variations in the focusing and diffusion of latent and potent nervous energy. Therapeutics must learn to distribute this force more evenly, and pedagogy to determine its place and degree of concentration.

Étude sur le zoomagnétisme. A. A. Liébeault. Nancy, 1883, 29 pp.

Forty-five children, most of them under three years of age, suffering from various diseases, each case of which is described in some detail, were cured or helped by the author's touch without pressure. Sometimes the hands were merely laid on, and sometimes the surface of the body was lightly stroked. From these results, which cannot be ascribed to heat or suggestion, the writer concludes that we must admit, along with the theory of suggestion held by the school of Nancy, that the fluidists are also partly right. Nervous vibrations or neurility can thus be transmitted during the waking state from an active to a passive or suffering organism. In his earlier and very important work on sleep, in 1866, the author had held that conscious thought has an equilibrating power which during artificial sleep can be made by suggestion to transport the nervous force of the subject from points of the body where it is abundant to parts where it is deficient or needs excitation. Mental acts thus may diffuse energy from centres where its accumulation causes disorders to centres disordered by defect. With infants, touch redistributes energy and causes an organic calm without mental action. People of energetic, sanguine combustion impress others most strongly. We must admit an irreducible force, *sui generis*, and of great therapeutic power. The motto of this pamphlet is, "He was in the world and the world knew him not." The author's protest against the infallibility of academies, and his bitter words concerning the neglect and scorn often meted out to great discoverers, remind us, in view of the fact that it was his great work, above referred to, which gave its character to the Nancy school, and the theory which he now so sadly lapses from in his old age, of the no less just complaint of Sterling, the originator of the modern idealistic movement in England, of similar want of recognition.

De la suggestion hypnotique, dans ses rapports avec le droit civil et le droit criminel. I. Liègeois. Paris, 1884, 70 pp.

This often cited memoir, by a distinguished jurist, recognizes the unconscious fatality with which hypnotic suggestions are often

enforced, which may render the subject powerless against criminal tentatives. He realizes that souvenirs which are effaced in the waking state may be revived by new hypnotization. Even days after they are suggested to them, hypnotic subjects may commit crime for which they should be held irresponsible, and for which the suggester alone should be punished. Courts should not have power to hypnotize witnesses to obtain from them confessions, or testimony against others. This should apply to all civil acts, wills, etc. If a victim of a crime, or an accused person, however, demands the test of hypnotism for himself, it may be granted under certain specified conditions. It is recognized that to certain persons in a state of apparent waking, suggestions of acts may be effectively given. This, of course, is a point of great importance in criminal practice. No one should be hypnotized save in the presence of witnesses. Hypnotization is the discovery, not the creation, of the capacity of being morally and mentally vivisected. This work contains references to many interesting legal cases.

De l'origine des effets curatifs de l'hypnotisme, étude de psychologie expérimentale. J. DELBOEUF. Paris, 1887, 42 pp.

After visiting the Salpêtrière, and experimenting much himself, this observer, whose admirable work on dreams had qualified him to express an opinion, attempts to explain hypnotism as a therapeutic agent as follows: Commonly, the organism and tissues under the influence of the great sympathetic system of nerves are withdrawn from the action of the will. The hemispheres do not normally interfere with the functions of the non-striated muscles, the vasomotors, glands, etc., or at least if they interfere their role is complicated and obscure. This was not always so. As we descend the animal scale toward protoplasm, organisms were sensibly affected by all that passed within them as well as on their periphery. With the division of work, and the development of the senses charged with expanding external relations with all that could help or mar the integrity of the individual, and other organs of attack, defense, etc., the internal management was committed more and more to a servant which consciousness had trained till it could be trusted to act for itself. The life of relations thus absorbs attention from vegetative functions. In the hypnotic state, however, the subject may violently withdraw from the external world and all his energy is directed to any suggested point. If any internal function has fallen out of order, the higher brain forces can be turned on to it, as an object long neglected but not all unknown, and often with the best curative effects.

Force psychique et suggestion mentale. Dr. CLAUDE PERRONNET. Paris, 1886, 72 pp.

The author, who is a professor of philosophy, holds that the best register of undulations produced in the periphery of the body by the action of thought, is a subject who has been hypnotized and deprived of personal dreams. He would replace the theory of fluidism by that of "undulationism." He has hypnotized 423 patients suffering from nervous diseases, six-sevenths of them women. Of this total number, 288 were essentially improved by mental suggestion. Catalepsy, hysteria, migraine and epilepsy were most often helped, and in this order.

Les suggestions hypnotiques, une lacune dans la loi. F. DELACROIX. Paris, 1887, 47 pp.

The reform for which this magistrate pleads is summed up in the new legal provision he proposes, viz: 1. No one shall practice hypnotism unless he be a duly authorized physician, and be assisted by a second physician especially licensed upon this topic. All public exhibitions of hypnotism, save in schools and laboratories legally chartered, should be forbidden. 2. All infractions of this article shall be punished by imprisonment of from six days to two years, and by a fine of from 16 to 2000 francs, or by one of these alone.

Le magnétisme animal. Dr. F. BOETLY. 2nd ed. 1886, 292 pp.

The author writes in the atmosphere of the Salpêtrière. His book is probably the best presentation of the whole subject in its space, which is much less than that occupied by Binet and Féré. There are slight experimental and critical additions.

Du sommeil provoqué chez les hystériques. Essai d'explication psychologique de ses causes et ses effets. A. ESPINAS. Bordeaux, 1884, 29 pp.

The initial cause of induced sleep in hysterical subjects is the exhaustion of the higher centres by excitation. In normal persons the nervous elements contain a considerable quantity of force *en tension*. In hysterical persons the quantity of this force in each nervous element is small. In the case of normal persons, peripheral excitations which tend to set free the nervous force *en tension* meet with a strong resistance when they reach the higher centres. The higher centres act as centres of arrest by checking the movements which the peripheral excitations would produce if they were permitted to reach the motor centres. In hysterical persons, on the other hand, the excitations which exceed a certain degree of intensity do not meet any resistance from the higher centres in their passage to the ideo-motor centres, and therefore these excitations set free the nervous force in the ideo-motor centres. Thus because of the small quantity of nervous force, the higher centres are easily exhausted and the peripheral excitations are left unobstructed. The exhaustion of the activity of the centres of ideation causes a diminution, if not a suppression, of all sensorial or cutaneous sensibility, and this in turn produces a diminution or suppression of consciousness. According to Professor Espinas, then, that which makes hysterical individuals subject to hypnotism is the weak condition of the higher centres which are easily exhausted, and which diminishes consciousness according to the degree of exhaustion. C. A. O.

After witnessing the hypnotic exhibitions of Señor Das, at the Spanish court, in January of this year, the *Hann. Cour.* reports that Queen Christine is said to have completely hypnotized a young lady of the court who showed remarkable powers of clairvoyance, if the detailed report can be relied on. After rousing the young lady, the Queen asked Señor Das if the power to excite magnetism resided in all persons, and was told that it slumbered in all who had irresistible power of will and perfect concentration of thought. The Queen then desired to be hypnotized, but although the strongest means were tried for some time, the Queen was not only unaffected, but seemed to

show greater power of will than the professor himself. Two German journals, however, report that the experiment succeeded, but one of them expresses the hope that it did not, on account of the grave consequences that might have befallen the country had the Queen really developed this high degree of suggestibility.

We have above attempted to present to our readers a digest of the chief representative books illustrating the different lines of experiment and observations and the different theoretic standpoints lately developed concerning hypnotism. There are other large works and countless smaller ones, besides all the contents of the *Revue de l'Hypnotisme*, edited by Dr. Edgar Berillon, and a growing number of works of French fiction occupied either chiefly or incidentally with multiplex personality, telepathy, transfer, or other spurious or genuine phenomena of hypnotism. In a future number we hope to publish results of a line of research already long under way in the psychophysic rooms of this university, which we believe shed additional light on one important group of these facts. One moral of all this movement is most obvious and impressive, viz. that physicians cannot study these phenomena with safety to their scientific reputation without more training in modern psychology than even the best medical schools either in France or in our own country now afford. To this we shall recur at length later.

III.—EXPERIMENTAL.

Ueber Holmgren's vermeintlichen Nachweis der Elementarempfindungen des Gesichtssinns. E. Hering. Pflüger's Archiv, Vol. 40, p. 1.

Holmgren is supposed to have proved, by some experiments which he described before the Medical Congress in Copenhagen in 1884, that the Young-Helmholtz theory of color sensation is the correct theory. His plan was to throw a very small and sharp image of a very small hole in a metal plate on the retina. If the diameter of the image is smaller than that of a cone, then white light ought to look red, green or violet according as it falls upon one or another of the cones of a cone triad ; if it falls half way between two it ought to look purple, yellow or blue, and only when it hits all three equally would it look white. If only saturated yellow light is allowed to come through the hole it may look red or green, but never violet or white. A white hole ought then to look in general colored, and only occasionally white ; that is, provided (1) that the theory is true, (2) that a small enough image can be produced, and (3) that in spite of the constant, rapid, involuntary motions of the eye, the different sensations furnished by the different cones can be distinguished in consciousness. Holmgren succeeded in his experiments with homogeneous yellow light from a spectrum. He was less successful with blue light, and he does not seem to have tried white light. Hering criticises his method and, on repeating his experiments, failed to obtain his results.

Holmgren says that after struggling for some time with the difficulty of producing a sufficiently sharp image on the retina, he hit upon the idea of using a telescope, and that this instrument must hereafter be looked upon as an indispensable aid to all experiments of this sort. Hering says that this is surprising ; for producing a

small sharp image one should use what Volkmann calls a makroscopic arrangement, that is, the objective of a telescope so arranged that the real, diminished image formed by it may be looked at by the naked eye at the proper distance for distinct vision. Spherical aberration is to be guarded against by a diaphragm with opening smaller than that of the pupil, but not so small as to allow insufficient light to pass through, nor as to let diffraction about the edge interfere with the image. This arrangement is what is always used to determine the fineness of vision of the retina, and to find out how small a colored object must be to lose its color. If a hole 1 mm. big is looked at at a distance of 1 m. its image is already less than the diameter of a cone in the fovea; if it is put at a distance of 5 m. and looked at with a telescope which magnifies five times there would be, theoretically, no change in the size of the image, and hence nothing would be gained by the telescope; but what Hering has called the aberration region (to be distinguished from the dispersion region, due to incorrect accommodation) *might* be greater than without the telescope and with the diaphragm, if the cone of light which enters the eye were greater. But the "bright spot" in front of the telescope is in general smaller than the pupil, and Hering does not say that he makes the aperture in his diaphragm *very much smaller* than the pupil; hence he does not seem to have established that the use of the telescope, with proper precautions, is particularly injurious.

Hering's next criticism is that Holmgren in moving his eye may have allowed now one side and now the other side of his pupil to become covered by the dark part of the telescope. This would lead to a known source of error. If a narrow line of light, formed by one card held parallel to another but several feet in front of it, be looked at with one eye, its borders appear red and blue. This is because the aberration region, which is usually white on account of the superposition of rings of color on one side of the green upon rings of color on the other side of the green, has now half of each set of rings cut off, and hence is blue on one side and red on the other, or, with yellow light, red on one side and green on the other. This objection would be without force if Holmgren had used absolutely homogeneous light, and Hering's next step is to show that he did not take sufficient precautions to that end. An absolutely homogeneous spectral light can be had only if the hole is exactly in the plane of (the image of) the spectrum. With the hole in any other position, rays of different refrangibility can get through, and as they are moving in different directions, a change in the position of the eye will cause the spot to look now of one color and now of another. That yellow should easily become red or green, but that green should not become yellow and blue, is owing to the fact that with a feeble light the yellow and blue of the spectrum are of particularly feeble intensity. A very feeble spectrum looks red, green and violet only, as is well known.

Hering repeated the experiments, using a metal plate with a very thin spot in it, and a conical hole in the centre of the thin spot .09 mm. in diameter at the small end. The plane of the hole was in the plane of the spectrum, and 20 cm. in front of it was a Hartnack objective system with a diaphragm. When the eye, properly guarded from extraneous light, was at the right distance, different for different wave lengths, the calculated size of the image was less than that of a small cone, and sometimes only one fourth as great.

With this arrangement the Holmgren effect was not obtained, but yellow light did become red and green, both with and without a telescope, when the arrangement of the apparatus was inexact. It seems singular that Holmgren did not try the light of sodium in a Bunsen flame. With the sodium, lithium and thallium flame Hering was not able to obtain any change of color at all. He observed, what was known before, that yellow becomes white with diminished intensity, green very rapidly so, and red not at all. He observed also that weak blue points cannot be seen at all by direct vision (on account of absorption by the yellow spot), and that green and white points are strikingly brighter in indirect vision.

Holmgren says that white light might be tried, but that, "*der Kürze wegen*," he used only spectral light. There are certain points in nature which can be looked at in much shorter time than small holes lighted up by the spectrum,—they are the stars. Even when looked at through the telescope they present no change of color with change of position of the eye: it seems impossible that this should be the case if Holmgren's experiments were to be relied upon.

Hering's argument is not at all skillfully carried out, but nevertheless it seems to be quite conclusive against Holmgren's inferences. It does nothing to *disprove* the Young-Helmholtz theory of color sensation, though it would be very effective against it if it could be shown that the image on the retina had been shorn of its aberration circle. Helmholtz himself has said, however, that there is no reason for supposing that the three different sensations may not be three different activities in one and the same cone, and that the supposition of three cones is kept up merely for the sake of greater facility in speaking about the matter. CHRISTINE LADD-FRANKLIN.

Die Gesetzmässigkeit des Helligkeitscontrastes. H. EBBINGHAUS, Berlin. Sitzber. der K. Preuss. Akad. der Wissensch. zu Berlin, 1887, Sitzung vom 1. December. 15 pp.

To this very difficult topic of experimental psychology Dr. Ebbinghaus, whose study of the laws of memory is deservedly well known, makes a very valuable contribution. He succeeded in preparing a series of papers varying through shades of gray from the whitest white to the blackest black, and was able to get 53 such shades differing by objectively equal differences of brightness. The general tone of the grays was approximated to that produced by the rotation of pure black with pure white. He cut disks 2 cm. in diameter from these various papers, and placing a given disk on a background of its own shade, he found what shade of disk he had to place upon a background of a different degree of brightness in order that the two disks shall seem equally bright. It is evident that the difference in brightness of the two disks measures the amount of contrast. Working with great attention to details and with conditions analogous to those that the eye is subjected to in our every-day vision, he deduced from a large number of experiments the following laws: 1. Disks placed upon a background darker than their own shade of gray have their brightness *increased* by an amount that is closely proportional to the difference in brightness between disk and ground, but is independent of the absolute brightness of the ground. On the average the brightening by contrast is from one quarter to one fifth of the difference between disk and ground. 2. A disk placed upon a darker ground has its brightness *diminished* proportionally to

the difference between disk and ground taken independently of the absolute shade of the ground. In addition the darkening is dependent upon the brightness of the ground, being inversely as the brightness of this ground when the differences between disk and ground are equal. The amount of contrast is .3 of the difference between disk and ground, divided by the brightness of the ground. These laws yield the formulae, (1) $+c = K(h - H)$ where $h > H$, and (2) $-\frac{c}{h} = K' \frac{(h-H)}{H}$ where $h < H$; or $-c = K'(h - H)\frac{h}{H}$; where $+c$ indicates the brightening due to contrast, $-c$ the darkening, h the brightness of the disk, and H that of the background, K, K' constants depending on individuals and conditions. An interesting deduction from the second law is that the darkening by contrast has its maximum effect when the ground has upon it a disk of half its own brightness.

Lehmann had studied the problem of contrast with rotating disks, and Ebbinghaus is able to show that the first law is deducible from the former's results, his constant being .226. Of the second law, however, no trace is to be found in Lehmann's results, which is considered as due to unfavorable conditions of experimentation. By way of explanation of the phenomena the author believes the process to be in the retina itself, and supposes a change in sensitiveness of the different portions of the retina due to slight variations in the blood supply.

The second part of the paper is devoted to a test of Weber's law. If a series of shades be arranged, the ratios forming a geometrical progression, the intervals of brightness will not seem the same throughout the scale, as Weber's law demands, but both at the upper and at the lower ends the intervals will seem too small, while even in the medium portion slight differences can be detected. Conversely, if we arrange a series of shades that, as far as these papers allow us to do, seem equally different (the comparison being made pair by pair), we will not get an exact geometrical series. But if we have in mind only general approximate results we can say that within the limits of black and white, with which we ordinarily have to do, a series of subjectively equal intervals of sensations of brightness has objectively corresponding to it a geometrical series of light intensities. Dividing the field of shades into seven divisions, the ratio for passing from one to the other, from below upwards, was found to be 2.25, 2.11, 2.05, 1.77, 1.72, 1.68, 1.98. J. J.

Ueber die Unterschiedsempfindlichkeit für Tonhöhen. EDWARD LUFT. Philosophische Studien, IV, 4, 1888.

From the fact that we regard tone intervals as equal when the ratio of their vibration rates is the same, Fechner inferred that Weber's law is valid for sensations of musical pitch. The validity of this inference was questioned by Preyer, who suggested that this perception of the equality of intervals might be due to the occurrence of overtones and so on, and furthermore showed that the smallest perceptible difference in the pitch of two tones was not proportional to their vibration rate, but much more nearly approached constancy for all tones of a medium pitch. Luft subjects the results of Preyer and others to a fair and discerning criticism, and makes a series of observations in which care was taken to have the tones equal in intensity, the latter being the point in which Fechner saw the weak-

ness of Preyer's results. A series of tuning-forks of 64, 128, 256, 512, 1024, and 2048 vibrations per second were connected with resonator boxes that could be opened at will; on one prong of the forks was arranged a mechanism by which its tone could be slightly and measurably altered. This consisted of a screw sliding a weight up or down along a millimeter scale. The observation consisted in slightly altering one of the forks of the same vibration rates, and by several slight adjustments, first from below the point of perceptibility to above it and then *vice versa*, to infer the point when the difference was just perceptible, as also the point when the two tones were first declared equal—Wundt's well known modification of the method of "just observable difference." The result can be most briefly expressed by taking the average between the mean determination of the point of "observable difference" and the point of "equality." This is given for Luft himself in the following table:

No. of vibrations,	64	128	256	512	1024	2048
Observable difference,	.149	.159	.232	.251	.218	.362

The first number, for example, indicates that a change of .149 of a vibration per second of a fork vibrating 64 times per second is just perceptible to the ear as a difference in pitch, but, as is true throughout, without an appreciation of the direction (whether higher or lower) of this difference. If Weber's law were true these numbers should be (taking .149 or .15 as the standard) .15, .30, .60, 1.20, 2.40, 4.80. One sees at once that Weber's law does not at all hold, there being a much greater approximation to a constancy (about .2 of a vibration per second) in the just observable difference of tones between 64 and 1024 vibrations per second. Above and below this point the sensibility undoubtedly decreases, but probably not in the ratio demanded by Weber's law. Other points of importance are that the effect of practice is very marked and must first be eliminated; that this effect is decidedly greater with low than with high notes; and that the effect of fatigue is also very evident.

Luft also made some determinations by the method of "right and wrong cases," but the method is so clumsily applied that an inference from the results has little value except to corroborate in a vague way the results already recorded. He thus agrees with Preyer, though the numerical results of the two are not comparable as they stand.

This well designed study suggests comment in two directions. In the first place, granted that Weber's law does not hold for differences of pitch (and this Fechner afterwards practically admitted), how can we explain the acute perception of the equality of tone intervals, and what psychophysic bearing has this perception? In the second place, this study is unsatisfactory because it could so easily have been more valuable. It is an instance of a good observer hampered by a poor method. The object of experimentation is to reduce subjective influences to a minimum, while the method of the "just observable difference" brings them to the front. Not until results obtained in Leipzig can be repeated elsewhere with as great an assurance of reaching the same conclusion as the nature of the experiment warrants, will psychophysics be acknowledged an exact science; and the first step in that direction is the employment of controllable and logically justifiable methods. The methods employed in this research would not pass such a test. J. J.

Ueber den Einfluss einer Sinneserregung auf die übrigen Sinnesempfindungen. VICTOR URBANTSCHITSCH. Pflüger's Archiv f. d. ges. Physiologie, XLII, 3-4, 1888.

The well known cross-associations between the senses, by which, for example, a piercing tone calls up a red color, etc., and of which Bleuler, Lehmann and Mr. Galton have given so able descriptions, suggested to the author an experimental investigation of the influence of a sense impression through one sense upon that through another. In particular he asked if one sense organ is stimulated with the smallest stimulus that will arouse a definite sensation of a certain kind, will the simultaneous excitation of another sense organ have an influence, favorable or otherwise, upon the perception of the first? This question he answers in the affirmative for almost every type of sensation. It will only be necessary to sample his observations here and there, asking the reader to remember that almost any pair of sensations that he selects will have a similar influence to that described.

(1.) Patches of color are seen at a distance at which the color can scarcely be made out; a tuning-fork is sounded and the general result is that colors formerly not visible are brought into the sensory field; as Fechner would state it, the threshold is lowered. Tuning-forks applied to both ears, high-pitched forks, are most influential; and wide individual variations characterize all the results, in some cases even reversing the usual result. The influence upon different colors is also variable. Barely legible print is often read when a sound accompanies the effort. Sounds similarly influence smells, tastes, and touches; the increase of pain by a jarring noise being brought under the last head.

(2.) A sound has its intensity decreased if the eyes be closed, increased if the illumination be brightened. Colors have a strong effect. In one case the ticking of a watch was made more distinct by the sight of red and green, less distinct by that of blue and yellow. The influence of sights upon musical tones is marked and various, the effect being different for high from what it is for low tones. Musically gifted persons show these phenomena best. Another curious phenomenon is the localization of tones in different parts of the person, transversely along the head in one case; and this arrangement, though very different from individual to individual, is remarkably constant in any one case. Sights also affect subjective noises, as the rushing in the ears, and stranger still, the effect of an impression upon one eye influences the sounds in the ear on the same side decidedly more than the other. The rapidity with which these effects arise and die out is also very variable, and some time measurements are noted. The influence of sights upon smell is difficult to detect, but upon taste is marked. Sensations of temperature, as also of pain, are increased by increase of illumination. Complementary colors seem to have a similar influence. The effects of color upon animal development and upon psychic conditions as Geothe suggested are also cited as relevant.

(3.) Smell has very slight reinforcing power over other senses, but is most marked with sounds.

(4.) Taste has greatest influence over colors, but no law is evident.

(5.) The influences of temperature and tactile sensations upon usual ones are very interesting, and especially so is the statement that the stimulation by heat or cold of one skin area decreases the tactile sensibility of another area, while a tactile stimulation has a favorable effect upon a temperature sensation.

Finally the author succeeded in producing the "photisms" or "sound colors," by having the subject look at a gray disk on white paper, and describe the color effects he perceived as different forks were sounded—a very important contribution to the subject. The persons who see colors when they hear sounds, or *vice versa*, are thus only marked examples of a normal physiological reaction of one sense upon another.

While the author has here made an important contribution to an obscure field of research, much corroboration of his results will be necessary before they can stand as final; his special laxity is in regard to objective tests (many of which suggest themselves) of the real nature of these peculiar sensory associations. J. J.

Neue Experimente über den Vorgang der einfachen Reaction auf Sinneseindrücke. LUDWIG LANGE. Wundt's Philos. Studien, IV, 4, pp. 479–511.

The chief contribution of this paper consists in the introduction of a new distinction in the analysis of psychic processes. While various observers have called attention to the fact that the psychic process in a simple reaction time was not always the same, they regarded the differences as mainly due to the effects of practice and normal individual variations, and they sought by taking the average of all reaction times to get a single result true for the average individual. Lange, on the contrary, holds that there are normally two methods of reacting to a simple sensory stimulus, which he distinguishes as "motor" and "sensory." In the "motor" type one does not think of the sense impression, but has the attention focused upon the preparation of the motor reaction; while in the "sensory" type every tendency to get the motion ready is avoided, the attention being directed to the sensory impression entirely; when the impression is received the reaction is to follow as soon as possible. These two types are of course perfectly distinct only in their extreme forms, and can be studied only in individuals of steady and self-possessed mental habits. Lange's object was to study the difference between "sensory" and "motor" reaction times in their extreme types. The sense impression was a sound preceded at a variable but controllable number of seconds by a "signal"; a further condition that seems to have worked admirably was the separation of operator and subject in different rooms and in communication by a telegraphic code. The interval between signal and stimulus was chosen for each individual at from one to three seconds according as seemed favorable to the quickest reactions. For three observers the average time of a reaction of the extreme "motor" type was .125, .137 and .123 second, while for the extreme "sensory" type it was .223, .224 and .230 second. The difference in time between the two is thus nearly .1 second, and the average variation of the several times from their mean is also larger in the "sensory" type. The "motor" is nearer the automatic stage, is probably less subject to individual and other fluctuations, while the "sensory" is nearer the conscious voluntary type of action. Furthermore, the reactions in anticipation of the sense impression never occur with the "sensory" type, but are difficult to avoid in "motor" reactions, because the point on which the attention is fixed tends to get first realized. Again, if a stimulus of an unexpected and totally different kind be given, it will always be reacted

upon by a "motor" subject, and will as regularly not be reacted upon by a person reacting in the "sensory" mode. Of Lange's acute theoretical analysis of these two activities only the main points can be here given.

Taking Wundt's well known scheme of the factors in a simple reaction, he concludes that in the "sensory" reaction with the attention fully on the alert, "apperception" and "perception" fuse into one process, while the "motor" reaction does not contain an apperceptive nor a voluntary factor, but is a psychic reflex in answer to a prepared setting of the voluntary apparatus. Anatomically the former process is in connection with the cerebrum, while reasons are given for associating the latter with the cerebellum.

This distinction of Lange's is very welcome, because it promises to reconcile the results of different observers; those who like Wundt naturally drift into the "sensory" mode of reacting, getting longer times than those who favor the motor type. Furthermore, the enormous effects of practice seem now explicable as the transition from the one mode of reacting to the other. J. J.

Sul Tempo di Percezione dei Colori. Drs. G. Buccola and G. Bordoni-Uffreduzzi. Rivista di Filosofia scientifica, Anno IV, Volume V, fasc. 1°, 1884.

This short paper gives the result of a series of careful experiments by two skilled experimenters upon the reaction time for different colors. They reacted, using the apparatus described by Buccola in his *La Legge del Tempo*, to the flash of a Geissler tube colored by the interposition of a plate of colored glass. They made their experiments from day to day at the same hour in the dark and excluded from the results any reactions that were disturbed by noise. These precautions, together with the skill and practice of the experimenters, give great regularity and consequent weight to their determinations. Red, blue, violet, and green were tested. The shortest average time was found for the last; but as this may have resulted from experimental conditions, it is not used for comparison with the others. Six series of thirty reactions each (fifteen for each observer, we judge) are given for each color. The average of the means of these is as follows:

	B.	BU.
Red,	0.153	0.160
Blue,	0.156	0.164
Violet,	0.161	0.168

In the quick perception of red they agree with Kunkel and with Ott and Prendergast. The authors suggest the advantage of study along the same lines on the evolution of the color sense and the determination of a psychometric spectrum to parallel the thermal, luminous and actinic spectra now distinguished. The subject of color perception is not without a certain practical side, since color figures so largely at present in railway and other signals. E. C. S.

Ueber die Grenzen der Wahrnehmung passiver Bewegungen. Dr. A. Goldscheider. Centralblatt für Physiologie, No. 10.

Dr. A. Goldscheider here contributes a valuable series of observations upon the perception of passive movements. He enclosed the

two terminal joints of the left forefinger in a thick rubber sheath to exclude sensations of pressure, and with the hand well supported, rested the finger in a comfortable position by a system of pulleys and compensating weights. He now determined how slight a movement at the joint brought about by a pull upon the finger (interphalangeal) could be detected. He found for the interphalangeal joint .072, .061 and .056 cm.; for the metacarpo-phalangeal .076, .070 and .057 cm. He found, too, that the rate of motion was an important factor, the above motions being detected only if they were performed within .06 second in the former case or .08 second in the latter. A motion about half the extent of those above recorded was detected if executed within $\frac{1}{40}$ second. It must be noted that the subject is entirely passive, and that the sensations other than those arising from the motion at the joint are practically eliminated.

J. J.

Psychologie mathématique et psychophysique. P. TANNERY. Revue philosophique, Février, 1888.

Under the above heading, M. Tannery, one of the most active critics of the mathematical side of psychophysics, reviews a series of recently issued pamphlets, some of which treat of the philosophic foundations of the concepts that underlie mathematical operations, and the others of the mathematical basis of a psychophysic system. The review of the former is significant as indicating the general appreciation of the intimate relation that exists between the application of philosophical truths to the sciences, and the abstract discussion of these truths to which both the logician and the mathematician contribute. Under the latter point of view, Dr. Elsas's critique of psychophysics, and the review of psychophysical formulae by Köhler in Wundt's *Studien*, form the basis of criticism. Dr. Elsas discusses two fundamental questions: the first, whether Fechner's mathematical formulae are deducible from the observed facts; the second, whether a psychophysic system in Fechner's sense is possible. To both these questions he gives a negative answer. Under the first head he argues that the facts of Weber's law can be expressed by several mathematical formulae, each as good as the other, and yet contradictory among themselves; under the second he considers quantity applicable only to the physiological representative of the sensation, and not to a relation between the physical and the psychical. M. Tannery declares himself in accord with both these positions, though he has other ways of stating them, and is perhaps more ready to expect future experimentation to decide as to the most adequate mathematical statement of psychophysical facts. Köhler's article is a very useful one, because it allows of a survey of the many formulae that have been proposed instead of Fechner's, and inevitably suggests the conviction, as Tannery points out, that the entire topic is obscure by reason of the confusion of distinct questions with one another. Köhler, himself accepts the "just observable difference" as a real entity and a unit of measure; and this premise prevents him from recognizing the merit of the work of Delboeuf, a very important contribution to the subject. He lays stress upon the distinction of Wundt between the sensation and the apperception of the same, and perhaps it will be by a firm adherence to this and other distinctions that the mist will be raised from this important part of experimental psychology. A hopeful indication in this direction is furnished by

the fact that almost all of the recent writers upon the topic have freed themselves from the uncritical conceptions that Fechner introduced, and agree in the main upon a general end which the establishment of a psychophysics has in view. J. J.

Die Deutung der psychophysischen Gesetze. AD. ELSAS. Philosophische Monatshefte, XXIV, 3 und 4, 1887.

This article forms part of a controversy regarding the fundamental validity and import of the psychophysic law, which has been raging since the appearance of Fechner's first work in this field, and had busied the founder of psychophysics up to the day of his death. It will hardly be feasible to recount here the many and detailed issues which the author takes with Fechner's theories, but a brief notice of their general features is in place, especially as the attack is directed against the most fundamental parts of Fechner's work, and in fact, if accepted, as it promises to be, will be so entirely subversive of much of Fechner's mathematical deductions that Dr. Elsas acknowledges his trepidation in taking so bold a position. Fechner uses mathematical principles, says the author, not as tools, but as a magic wand by which what is not contained in the facts can be brought out of them, neglecting to remember that mathematical aids can only simplify and arrange what is implicit in the facts as ordinarily stated. Fechner passes from Weber's law, which simply states the dependence of the perceptibility of a difference between sensations upon the ratio of the stimuli that gave rise to them, to the logarithmic form of the law by aid of a comprehensive mathematical theorem ("Hülfsprincip"). Dr. Elsas shows conclusively that this principle is unnecessary, and that its agreement with fact in the application of it made by Fechner must be regarded as accidental. Again, Fechner's deductions start with the assumption that sensations can be summated; this the author refuses to accept, and points to the sensations of tone intervals, in which the summation does not give the effect of the resulting interval, but it requires the product to do so. Once more, the "relational hypothesis," as Fechner terms his exposition of the law, is only one of a number of possible hypotheses that fit the facts quite as well as does Fechner's, and the decisive ground of choice between them depends on considerations of naturalness which Fechner hardly touches upon. Fechner sees in the fact that his formulae take into account the existence of the threshold a valuable proof of their validity; Dr. Elsas shows that other formulae have the same merit, and that the threshold is made mechanically necessary by the physiological adaptations of the organism. In fine, the author holds that Fechner's mathematical deductions are irrelevant, that they lead to a false view of the entire field of psychophysics, and that they neglect to consider the natural, physiological import of the facts which it is the aim of that science to coordinate and systematize.
J. J.

Die Willenshandlung: ein Beitrag zur physiologischen Psychologie. HUGO MÜNSTERBERG. Freiburg, 1. B., 1888, 163 pp.

In his preface the author tells us that his first plan in writing a work on the Will was to prepare a general treatise, setting forth in the first part the physiology and pathology of the neuro-muscular system, whose function it is to conduct voluntary movements; in the second, to present the psychology of the will and make connec-

tion with the historic theoretical solutions of the problem; and in the third part, to propound his own theory of the will and indicate the relations of the topic to science and philosophy in general. For various reasons he abandoned this design and decided to publish the present contribution, containing an outline of his own theoretical views. The work reveals this origin in a disjointedness of some of its portions that makes it difficult to read and still more so to résumé.

In the introduction he explains that it is not his object to enter into metaphysical considerations, but to attempt to bring into harmony the various physiological and psychological facts of voluntary action. This he does under three heads. The first section treats of the "voluntary action as a motor process," and carries out with great suggestiveness the view that all action is at bottom of the type of a simple reflex act of greater or less complexity. The difference in complexity is of course enormous, especially so when the reaction follows only after a long interval and indirectly, but the fact that all acts find a place in the scale that begins in the simplest contraction is to him the important one. Closely connected with this point is the prominence of the evolutionary doctrine throughout his treatise. A sensori-motor mechanism is the result of an adaptation to the environment by evolution; the less completely adapted mechanisms failing to survive. This conception of all action as a useful reaction upon the stimulus furnished by the environment is carried all the way up, even to acts where the social factor is uppermost, where action becomes conduct, and forms one of the most interesting portions of the work. "The voluntary action as a phenomenon of consciousness" is the title of the second section of the work. It consists in the main of an analysis of the factors in a voluntary act, bringing to the front the "innervation feeling." This feeling is the important point, and when it is anticipatory the act that arouses it becomes voluntary. An act cannot be voluntary the first time it is performed; to learn how to perform a new combination of movements we must get the feeling of the accomplished result. The third section ("the voluntary action as a conscious motion") considers the various theories of voluntary motion, especially such as are based upon physiological experimentation, and criticises their weaknesses. His own interpretation of the voluntary process is founded upon the sensori-motor nature of all action. No brain-centre can be motor alone or sensory alone, but both at once. The various parts of the brain serve the purposes of various kinds of sensori-motor reactions, differing not only in complexity, but in the nature of their associations.

Dr. Münsterberg's treatment of the will coincides in many points with that recently sketched in an essay by Prof. William James, and it is important not only as a convenient compend of an interesting theoretical chapter of physiological psychology, but also because it suggests leading lines of thought by which the results of experimentation are to be interpreted.
J. J.

Ueber das Geruchsvermögen der Krebse. Inaug. Dis. K. May. Kiel, 1887.

This is a painstaking attempt to determine the anatomy of the olfactory "hairs" of the crab, the chemical composition of their viscus content, and their physiology, by a pupil of Professor Hensen, whose work on auditory hairs has been so fruitful. His conclusions are that the neural content of these hairs near the end of the anten-

nula reacts, by either molecular change or transposition, to odors, and that the disturbance is carried to the centre by nerve fibrils emerging from these hairs. The sum of the surface of these hairs and the number of nerve elements is very large for the size of the animal. However multifarious the olfactory sensations of the crab, one smell, viz. that of decaying fish, is perceived at great distance in darkness. The nerve fibres which go to each hair, and which end in the ganglion, are seen to divide into many fibrillæ. Each hair is a perceptive element. The simple stimulus affecting each hair is met by many fibrillar sensory elements. Thus on the principle of specific energy olfactory sensation cannot be simple, but composed of mixtures of a number of fundamental sensations. Possibly elemental odors corresponding to each species of olfactory fibre may some time be made out by experiment and analysis. Unities of the first order, Professor Hensen appends, may be the designation of the 40 to 100 hairs, and which might be characterized by their order on the antennula. The single fibrillæ and ganglion cells—about twenty to each hair—may be called unities of the second order. With these latter we must start, assuming that their functions are at least not identical, or else the arrangement would be like that of auditory hairs of crabs, to each of which but one hair and one ganglion cell belong. The three or four fibrils each of tactile hairs give one for the bending of the hair in each direction, while by olfactory hairs the specialization of function represents differences of chemical action. Further, as some fibrils are more central than others, not only quantitative but qualitative differences might arise as odorous substances acted penetratingly or superficially upon the content of the hairs. Different hairs, too, may not only control each other and intensify effects, but, as their nutrition and composition may be different, may afford basis for further differentiation of perceptive analysis. Thus Hensen's theory of assimilating and dissimilating processes does not necessarily apply here.

Ueber die Veränderung der Tastempfindung durch Heilmittel. Inaug. Diss. L. Israel. Würzburg, 1887.

Caustic lime, nitric acid, chlorate of zinc, sulphuric acid, iodine, chlorine, bromine, phenol, mustard, cantharides, croton oil, ether, alcohol, chloroform, morphine, carbolic acid, strychnine, ergot, arsenic, nitrate of amyl, oxalic acid, several aniline dies, aconite, quinine, and other substances in fit solutions were applied to the skin and the resulting sensations noted, and the sensibility in discriminating compass points tested before and after the application. The results cannot be briefly stated, but the work is suggestive. Far more extended studies with each substance are needed to give results of great value. The entire paper occupies but about forty pages, and serves only to suggest further and more detailed work in the same direction, which seems very inviting and very promising both practically and scientifically.

Die Beeinflussung unserer Hauttemperatur durch Amylnitrit. Inaug. Diss. F. Lahnstein. Würzburg.

The inhalation of fumes of nitrate of amyl was found, when measured on a thermoscopic-galvanometric apparatus, to cause an increase of over three degrees C. in the superficial temperature of

the skin. This increase was first and greatest in the head and neck, and decreased downward. If after complete cessation of first effects a second and third inhalation followed, it was found that the latter showed greater increase than the first. The subjective sensation of heat lasted 12 to 15 minutes, but the objective after effects lasted somewhat longer.

Ueber die Ziele und Ergebnisse der experimentellen Psychologie. Vortrag gehalten im academischen philosophischen Verein zu Bonn. Dr. GÖTZ MARTIUS, Privatdocent der Philosophie. Bonn, 1888, 24 pp.

The object of this address is a very practical one. It is to explain the objects of and excite an interest in the study of experimental psychology amongst the members of the University of Bonn, in the hopes of establishing at Bonn a laboratory where the progress of experimental psychology may be advanced. The contents of the address are well suited to its object. In a necessarily hasty manner some of the chief avenues of research that have been opened up by the introduction of the methods of science into the sphere of mental phenomena (psychophysic law, reaction times, rhythm, memory, etc., etc.,) are referred to; and the necessity of a laboratory with special apparatus, and special instructors trained in the methods of the new psychology, is well emphasized. This effort to extend the teaching of experimental psychology throughout all the German universities is an extremely significant one, and it is to be hoped that the appeal of Prof. Lipps and Dr. Martius will soon show a practical result; at the same time serving as an impetus for other universities to follow in its footsteps. J. J.

IV.—ABNORMAL.

Ueber Erinnerungsfälschungen. EMIL KRAPELIN. Arch. f. Psychiatrie, 1886, No. 4; 1887, Nos. 1 and 2.

The author of these three articles prefers the term "falsification of memory" or paramnesia, to Sanders' "illusions of memory," for those cases where present situations or events seem to have been experienced before, and points out their analogy with hallucination and illusion of the senses, when (1) in *simple* cases fancy-pictures arise freely and enter consciousness with a pretense of real reproduction or reminiscence of experience; (2) in *associated* cases the sense of personal experience is called out by analogous present impressions; (3) the present situation seems a photographic reproduction with all its details of a past experience. This is called *identifying falsification of memory*.

I. What is heard, read, or even fancied, like boasting lies of adventure, often becomes confused with reality. This seems the case with the tales of greatness of general paralytics, who become a part of all they have heard, seen, or fancied, and their pseudo-recollections are inseparably mixed with their delusions of greatness. Both at least grow from the same ground and have the same content. Strong hopes and also passions affect the normal man's conception of his present surroundings, and the critical faculty is too enfeebled to distinguish between fact and fancy, even in the present, and still less in memory. Scenes may be pictured so vividly that the consciousness of false-

hood, though present, is too feeble and dim to be effective. In intervals of remission patients wonder that they could have believed their ideas of greatness. There is also a type of maniacal insanity that narrates the most absurd personal experiences with the best of faith. Twelve interesting cases are described. The true and false trains of reminiscence may go side by side, very imperfectly fused, and both be alike subjectively certain. Sometimes falsifications of memory appear like imperative forms and are resisted for a time. They are far more likely to be of the remote than of the immediate past, and are on the whole apt to be vague. They are due not so much to enfeeblement of the critical faculty, or to general weakness of mind, as to special vividness of fancy images, accompanied often with dreamy obnubilation. Sometimes instead of sporadic illusions of memory, the latter are so systematized and real as to control every thought and act, and real events make impressions as fugitive as dream images on awakening, leaving no trace behind. All such falsifications are peculiarly characteristic of paralytic dementia. Sometimes impressions of delirium and hallucination seem recollections, when viewed retrospectively, when they did not seem real at the time. Dreams, especially of sexual adventure and of travels, often seem real. Substitution of this sort is not very generally due to the fact that subjective states are dwelt on or repeated, while objective experience is ever variable, for patients often unfold a train of reminiscence extempore upon any theme, and sometimes cannot repeat the same pseudo-experience twice alike, translocalizations in time being especially common. In one case a delirious boy became the hero of a lately read romance with great consistency and detail after his memory had been weakened by over-study and prostration. Sometimes the same experience is repeated each day, but each time as a fresh experience, with oblivion of all previous narrative.

II. Most common here is confusion of persons, due to remodeling present to fit past impressions. This is favored by defective vision, and especially by fatigue, under the influence of which, even in normal life, new persons and pictures seem old and familiar. If remembered impressions lose their vigor they are distinguished from present impressions only with a certain effort. Difficult as it is to separate the idea of a person from his bodily appearance, it yet sometimes occurs even in dreams that a man's name, with elements of his personality, are joined to totally different physical characteristics. The rupture of such strong bonds of association and the institution of others exerts a far more potent influence than the sensuous memory image. The most striking dissimilarity between two persons has no force against their identification if inner voices, intuitions and revelations proclaim it. Very striking are a few cases in which each striking event soon developed the impression that it had been described to the patient or heard of by him before. One patient reproduced the exact words of a long conversation. Real impressions served as the impulse for the gradual unfoldment of these pseudo-reminiscences.

III. Identifying pseudo-reminiscences is the oldest and best known form. In normal experience this occurs as a result of a moment of fatigue, when our present surroundings seem unreal and sink for an instant to the consistency of memory pictures, and is not often due, as Emminghaus thinks, to the unreality caused by a too rapid flux of thought; nor, as Jensen thinks, to analogy of mood; nor often to the looming up of dreams; nor to real though obscure memory of

facts, as Neumann held, who also thought that often the present situation appeared doubled, as sensuous impression, and as thought at once, as if, as Angel explained, perception and apperception were divorced by fatigue, or the least retarded. Jensen's explanation by disparate action of the two hemispheres is disproved by contralateral hemianopsia and other recently observed phenomena, as van der Kalk has shown. Yet Jensen's view is adopted in Schüle's well known hand-book, and Huppert goes so far as to explain double memory by temporary incongruity of action of the two hemispheres by capillary apoplexy. The other view, first stated by Jensen, that some elements of real experience are involved as a nucleus, to which other elements are imagined, and this whole seems memory when only a part is so, was modified by Sander, Sully, Buccola, Emminghaus, who suggest that dreams vaguely recalled may take the place of this nucleus of experience. Perhaps, also, the reproduction is of vivid fancies from the adolescent period, when fancy is strongest. This sense of full agreement of a present with a supposed past, involving as it does the ego, is often momentary, the sense of identity vanishing with clearer insight. The sense of foreknowing dimly what is to happen, and the psychologic moment attending such experiences, is discussed and further cases are given. These important papers at the same time show the great difficulties of the subject, and give promise of better study and fuller knowledge of it.

De la déviation faciale dans l'hémiplégie hystérique. E. BRISSAND et P. MARIE. Le Progrès Médicale, Jan. and Feb. 1887.

According to Todd and Charcot, hysterical is distinguished from organic hemiplegia by the absence of paralysis of the face. Others have denied this exemption to be of any value as indicating hysterical origin. After passing in review chief symptoms, these authors conclude that there is no objective symptom by which organic can be distinguished from hysteric hemiplegia if the face is left out of account. Facial and lingual deviation in hysteric cases may at first closely resemble paralysis, but is due to contraction of muscles on the same, and not to paralysis of those of the opposite side, and is spasmodic and confined to one lip. This conclusion is illustrated by portraits of two male cases.

Ueber Hysterie bei Kindern. Inaug. Dis. P. RIESENFELD. Kiel, 1887.

This thesis begins with an extensive survey of the literature upon this subject since the thesis of H. Smidt (Strassburg, 1880), the limits of childhood being fixed at menstruation, or, if this be unknown, at 14 years of age. Nineteen new cases are described, including four boys. Heredity, anæmia, exhaustion, and parental indulgence are prominent causes. Moderate hardship and exposure, too, excite somatic resistance, and repress whims and excessive imagination. The imitative instinct of children should be more or less repressed, and sudden anger, grief and fear, and excessive desire to be interesting, should be avoided. It is more simple, sudden in advent and cure, less often associated with whims and moodiness than in adults.

Zur sexuellen Form des Verfolgungswahns. Inaug. Dis. A. GOTTLOB. Würzburg, 1887.

Five interesting cases of men are told which illustrate the tendency to unreasonable jealousy when from alcohol or other causes

their sexual power begins to decline. Drinkers are especially prone to delusions of persecution, with approaching impotence.

Ueber die psychischen Störungen des Klimakteriums. Inaug. Diss. J. Brühl. Würzburg, 1887.

Several new cases are well studied, and the views commonly held are carefully presented. The author takes a too gloomy view of the effects of the menopause upon sanity. Psychoses that originate in the involution period are more likely to be malign than otherwise, and mental alienation of the climacteric constitutes a very dangerous crisis. If predisposition, and especially if incipient disturbance exists, the prognosis is very bad.

Beitrag zur Kenntniss der Inactivitätsatrophie der Muskelfaser. Inaug. Diss. B. Steinert. Würzburg, 1887.

One day, after section of the motor nerve roots, the cross section of the gastrocnemius and sartorius muscles of the frog, measured with many precautions and in many specimens, was found increased, and also their weight increased. Their dry weight, however, was found to be reduced. The same seemed to be the case with the single muscle fibres. It thus appears that the first stage of atrophy of muscle fibres due to inaction is marked by an imbibition of water, thought to be due to loss of capillary tonicity. After two or three days permanent shrinkage of the muscle begins. The same results were obtained with rabbit muscles.

Fünf Fälle von Tumor Cerebelli. Inaug. Diss. M. Schomerus. Göttingen, 1887.

In a digest of the literature which follows the account of the cases, it appears that out of 204 cases thus far described, but 60 have felt dizziness, which is thought to be so characteristic a symptom of cerebellar disease. Out of 364 cases, 260, or 71 per cent, have suffered from headache; about 49 per cent suffer from nausea; 33 per cent from amblyopia and amaurosis; 4 per cent from astigmatism, and 15 per cent from aphasia. The fact is that the cerebellum can no longer be regarded as exclusively an organ of co-ordination. From tumors topical diagnosis cannot be made on account of intercranial pressure. The cerebellar ataxia, so fully described by Nothnagel as highly characteristic, is often wanting.

Ein Beitrag zur Kenntniss des Paralysis Agitans. Inaug. Diss. E. Lantzius-Beninga. Göttingen, 1887.

Paralysis agitans, shaking palsy, sclerotyrle festinans, or chorea procussiva, is a neurosis without demonstrable anatomical lesion, which Charcot and his pupil Ordenstein have studied with precision, and describe as peculiar tremor of voluntary muscles which ceases in sleep, and progressive weakness of muscles and other attendant symptoms. The right arm is by far most often attacked. Psychic excitement of all sorts increases it, and it often hinders falling to sleep. Fourteen cases are well, but not fully described.

Ein Fall von Aphasie und ein Fall von Aphasie mit Agraphie nach traumatischer Läsion der linken Grosshirn-hemisphäre. Inaug. Dis. TH. HEINEMANN. Würzburg, 1887.

A wood-chopper, aet. 30, and right-handed, received a severe blow on the left side of his head and became completely aphasic and persistently wrote from right to the left. His writing vocabulary was reduced to a few words, but after many efforts for many successive days he could write only "mirror script." This was written fairly well, but attempts to write normally produced only vain movements of the pencil. Slowly, after great labor, he reacquired the power to write normally. At the end of about two months he wrote and spoke about as well as before the injury. This is noteworthy as one of the best cases of "mirror script" in literature.

Vergleichende Uebersicht der Classificationen der Psychosen. Inaug. Dis. A. OEBBECKE. Strassburg, 1886.

This is a convenient conspectus of the more important systems of classifying mental diseases which have been prepared since the time of Esquirol and Griesinger. The methods of classification are themselves classified as unsystematic enumerations of clinical types (Plater, Kraepelin); types based on the course of disease, in which typic, progressive, and atypic are distinguished (Arndt); psychological (Erlenmeyer, Stark, who called all forms hyper or para states, and Keiser, with his receptive, active, and tranquil states) (Heinroth, Richarz, Griesinger); physical-anatomical (Lorry, Groos, Singowitz, and Meynert, who use circulating changes as an important factor); systems resting on the forms of morbid diathesis (Langermann, Jacobi, Morel); etiological (Skae), and with greater freedom of combination (Bucknill and Wille); anthropological, with especial account of the stage of development (Tuke, Schüle, Morselli, Krafft-Ebing); systems based on typical morbid elements (Guislain, Baillarger, Weiss). The individual morbid types introduced by each writer are also adduced.

V.—ANTHROPOLOGICAL.

Genie und Irrsinn, in ihren Beziehungen zum Gesetz, zur Kritik und zur Geschichte. C. LOMBROSO, Professor an der Universität Turin. From the Italian by A. Courth. Nos. 2313 to 2316 of Reclam's "Universal-Bibliothek." Leipzig, 1887. 12mo, 434 pp.

The question of the relations of genius and insanity is not a new one. Apart from the literary references found in ancient as well as modern writers, the French alienists, particularly Moreau de Tours, discussed the topic, giving currency to the notion that genius is a neurosis, diverging in several directions from the normal activity of the mind. Radestock, Sully, and others have reviewed the evidence in favor of this conclusion, aiming to further differentiate the type of genius that is allied to the morbid from the genius that is the product of superior brain activity, while Prof. Dilthey strongly antagonizes this entire conception of the great man. Dr. Lombroso (the author of the classic work upon the psychology of the criminal classes) contributes the most comprehensive study of this question that we possess. His point of view is very definite, holding that

the relation between genius and insanity is a very close and important one. Not only that many great men have been victims of nervous and mental disease, or have been closely related to persons thus deranged, but the very nature of the activity for which the world rewards them is often of an abnormal kind. The overworking of specialized brain centres, kindled into fever heat by an intense emotional strain, and not infrequently excited by artificial stimulants—the products that thus result are divided by a narrow and perhaps imaginary line from the vivid fancies of a deranged mind freed from the logic of fact; and conversely, among asylum inmates the instances of literary efforts of no mean order are numerous. Around this central idea the author clusters a mass of interesting and valuable illustrations, so full of suggestive cases and acute psychological comments that it is difficult to give any adequate account of the varied contents of the work. Instances of derangement in great men, including so noble a list as Comte, Schumann, Tasso, Swift, Lenau, Rousseau, Ampère, are graphically described. One chapter is devoted to the influence of the elements upon great men, and aims to show that the summer months, or rather the opening of the warm season, is most favorable to exalted mental activity, and the same is true of the insane. Another chapter studies the geography of the regions, particularly in Italy, in which an unusual number of great men are born. Here the conclusion, as far as there is one, favors the view that warm climates are productive of genius. The influence of race and environment upon greatness is traced. Genius like insanity is hereditary (unfortunately the latter is much more so than the former), and many of the influences that bring out great men increase the percentage of insanity. On the other side Dr. Lombroso cites case after case of madmen bursting out into poetry, amusing their companions with truly humorous sketches, evolving reformatory plans by no means devoid of sense. And if we turn to the fanatics that have influenced the course of history, many of whom would in our day find a shelter in the asylum, our list is increased in dignity as well as in number. The art of the insane is the subject of a special chapter. Another records the remarkable doings of a class of men whom we would call "cranks," while one of the most interesting chapters tells of the exploits of crazed reformers, almost every one of whom met with great success in attracting followers. Nor is the list of topics yet complete. The appendices trace the distribution of artists in Italy, of savants in France, and suggest more than one interesting educational conclusion. They give extracts from the diaries and other writings of the insane, describe the most notorious criminal insane, of which Guiteau serves as a good type, and include quite a complete collection of human follies. It must not, however, be concluded that Lombroso identifies genius and insanity. He distinctly differentiates them, while pointing out the many ties that bind them together, and shows that a large number of great men were free from all taint of mental impairment, and that the stroke of genius has its peculiar though not easily describable characteristics.

The problem here treated suffers from a lack of method. We are probably dealing with several problems in one, and if, instead of discussing the general relations between genius and insanity, we could apply the aid of statistical analysis, such as Mr. Galton has applied to the study of the heredity of genius, we could perhaps

unravel several of the knots in this intricate problem, and relieve the conclusions of much of their apparent paradoxical character. Be that as it may, Dr. Lombroso's work remains a valuable contribution to the subject, as well for the many facts he brings to bear upon it as for the points of view that he advances. J. J.

The Significance of Sex. JULIUS NELSON. The American Naturalist, Jan., Feb., March, 1887, 71 pp.

This is the first chapter of a detailed study, and presents the cytological aspects of the question. It is abundantly illustrated with karyokinetic diagrams, and has a pretty full bibliographical appendix. Sex is considered a secondary or evolved characteristic which we distinguish in the higher organisms, calling that female which produces ova, and that male which produces the spermatozoa. The reproductive cells are of one brotherhood with the other cells of the body, but are specialized in such a way that two cells from diverse individuals may fuse into one cell, which then, multiplying itself by division, builds up an organism like the parent. The offspring are sometimes not only differentiated dimorphically into the sexes, but polymorphically, as in hydroids. Many forms develop from cells that have not been fertilized ; the ova of parasites are frequently parthenogenetic, and in low forms even male parthenogenesis has been observed. Still lower, the gametal cells are so similar as not to be distinguished sexually in their conjugation ; and sexual generation is the exception in the lowest forms of life.

In the cell there is a substance known as *chromatin*, from its affinity for stains, which is most abundant in the nucleus, where it occurs as one or more spherical bodies, an intricately coiled filament, or as a network with coarser or finer meshes. When the cell divides, the chromatin passes through a cycle of transformations (karyokinesis), which shows that it is a very important substance. This conclusion is fully justified by all that we learn about chromatin in the different aspects of cell life. All cells while growing and multiplying possess it, and if deprived of it lose the power to regenerate lost parts. The yolk of eggs and the secretions of glands, and probably ordinary cell protoplasm, are mainly metamorphosed chromatin. In sexual fertilization, the essential phenomenon is the union of two pronuclei, one containing the chromatin of the ovum, the other that of the spermatozoan ; hence the chromatin must carry the hereditary characters, and therefore has been termed the *idioplasm.* (This word implies a psychological property, the full explanation of which requires an extended article to present.) The fundamental significance of sex is therefore involved in the questions, *Why are idioplasms from two individuals of a species blended when reproduction of higher forms has place, and how are these idioplasms structurally related?* The answers are deferred until a general discussion of the theory of heredity is taken up, but provisional statements are made to the effect that a union of diverse experiences, which broadens the cell education, must be advantageous in the struggle for existence. It is assumed that the idioplasm consists of an aggregation of *similar gemmules*, each of which can reproduce itself and whose progeny can build up an organism with its characters. These characters depend on the way in which the gemmules differentiate in building up the cell in the diverse forms obtaining in a complex organism whose unity is a reflex of the gemmule unit. J. N.

La criminalité comparée. G. TARDE. Paris, 1886.

The classical head, with its rectilinear nose, small mouth, moderate jaw, and ear close to the temple, is the exact opposite to the criminal type. Ugliness, if not monstrosity, characterizes the criminal face. That of the assassin is dull, cold, fixed, and that of the thief is oblique, wandering, restless. The criminal rarely blushes, is quite likely color-blind and strabismic, but sees to a great distance; is often ambidextrous and insensible to pain and cold, and can imitate well but cannot invent. The stability of a future civilization once firmly fixed in mental forms will be secured by expelling all kinds of crime from more and more of the great centres so it can enter only as inoculation from without, till after long wars and revolutions the purification will be complete and all men will exist in one truly civilized state, in which scientific truth will be held with such conviction that to know and bear witness to it will be the greatest good and not to know it the greatest evil.

Des attentats à la pudeur sur les petites filles. P. BERNARD. Thèse de Lyon, 1886.

Men guilty of rape are usually of ripe age, quite commonly widowers and often old men, the age of the violator being inversely as that of the victim. These crimes are most numerous in June and least so in November, and are most common in years of abundance. There seems to be a periodic augmentation of crimes of this nature. The mental state of the violators is but little discussed, and the alleged partial precocity of the victims, such as brilliancy of eyes as contrasted with the puerile aspect of the lower part of the face, etc., is hardly touched upon. In the second part of his treatise M. Bernard gives anatomical and other reasons for the conclusion that in these crimes normal vaginal intromission is rare.

Die physischen Bedingungen des Bewusstseins. ALEXANDER HERZEN. 1886.

The physical basis of consciousness rests on the biological law that the activity of a tissue is conditioned by its decomposition, and that regeneration immediately follows. Thus the intensity of consciousness as a function of neural tissue rests on the intensity of this decomposition, and is inversely as the ease and rapidity with which the inner work of one nerve element is transmitted to another, whether motor, sensory, or central. This is experimentally demonstrable by the greater development of heat by vivid conscious processes and the reduced heat attending automatic and instinctive acts. Thus tested, the spinal cord has an elementary unintelligent consciousness, most distinct in lower animals; the centres of sense and motion manifest the dawn of intelligence; the cortical centres show conscious intellect and will. This view, Buccola suggested, was illustrated most clearly in mania, where disintegration is widely diffused and transition to adjacent elements rapid but with feeble intensity, and also in hypermania and stupor, which are characterized by great intensity and slowness of transition. According to Herzen, the ego rests on conaesthesia and somatic sensations, and its continuity and unity, both very relative, are exclusively matters of memory. The psyche is thus represented as an expression of the physical ego; its unity is never complete, but is most nearly so the

more definite and constant the character is, and the greater the harmony between the moral conceptions and conduct.

Les phénomènes affectifs et les lois de leur apparition. FR. PAULHAN. 1887.

Consciousness is an incidental accompaniment of physiological processes which can all be reduced to reflex action. All problems of psychology are at bottom problems of physiology, the psychic process being the sign and the physiological change being the thing signified. Consciousness shows that the machine is a little out of order, or indicates an incomplete organization of a tendency. Pleasure measures increase in the completeness of organization, pain a decrease. The entire monograph is a speculative attempt to apply and work out these principles.

Die wissenschaftliche Charakter der Ethnologie. T. ACHELIS. Zeitschrift für Völkerpsychologie, Jan. 1887.

After long irregularity and at last practical suspension, this journal is now to be congratulated on beginning its seventeenth volume in new dress, with a new publisher, who proposes to pay a regular price for all accepted publications. The present article begins with the assumption of Ree that philosophy is now in a provisional stage. It stands for the sum of erroneous attempts to explain the facts in its field. Philosophy is now only history of philosophy. When the work of the new psychology is once well under way, hand-books of philosophy will be no more historical than a hand-book of physics now is. Experimental, introspective and speculative psychology are all more or less individual and limited in their scope. Inductive ethnology, which attempts to show the lines along which modern ideas, institutions and beliefs have developed, exhibits man in social relations. The day of subjective existence of the ego, of the theory of knowledge, has gone by, and with it all conceptions of a transcendental world of reason or spirits. Our psychophysic organism, which compels us to see all things double, as mechanical and psychic, is all that is left. In it are all the secrets of the world, and we shall never know it till we have studied and can explain the history of our consciousness. This is best to be learned in the field and by the methods of comparative ethnology, which will give us in the end the most objective view of the world attainable.

Religionsphilosophie auf modern-wissenschaftlicher Grundlage. Mit einem Vorwort von JULIUS BAUMANN. 1886. 230 pp.

All religion is an illusion, yet brings joy and blessing to all mankind. Lotze was right that the being of God cannot be proven. That God is the inner force of things means, interpreted according to the psychism of Feuerbach, which the author adopts, that the connections of things always call up the thought of an unitary power. That the finite cannot satisfy, and that God is the abiding good, means satisfaction is sure only when its conditions are internal. In the forms of exact science, religion is only subjective. We project and objectify by our inner experience into images of things divine. Man must not know this great secret that religious realities, not only in the field of Christianity but of the other great ethnic faiths, are subjective, for he must have a wide domain in which he can freely

idealize, and needs to this end art, poetry, superstition, and also true religion. As men believe in the curative power of bread pills, or as the robber thinks the empty pistol is loaded, and the end is secured, so faith in deities is salutary; but it is so in a far deeper sense, for here faith is being, reality. As man feels himself more worthy, his feeling of the dignity of deity increases. The non-ego out of which we arise must somehow have an egoity in it as cause of finite egos. The same is true of belief in immortality which is a remnant of idealism, which modern science or positivism, which eliminates all not an object of sensation, has destroyed. This book, it will thus be seen, is almost exactly in the line of Feuerbach, but far less able.

Die Seele indischer und hellenischer Philosophie in den Gespenstern moderner Geisterseherei. ADOLPH BASTIAN. Berlin, 1886.

The first impression made by this, as by others of the author's works, is confusing. Quotations from great men of all lands and in many languages stand beside the wisdom of Indian chiefs or African magic priests, with no very apparent order or end till the vast method and plan of the author, by which his amazing industry has been animated for so many years, is gradually understood. This is nothing less than to collect all the original and peculiar thoughts of all men everywhere, and to heroically renounce all system-making till these extensive data are mostly in. Meanwhile the latter will be gradually shooting together in a natural order, as by a kind of chemical affinity, and we shall then have a real phenomenology of the human mind. Only when this genetic-comparative method has done its work can the highest of all methods of finding the truth, the speculative, begin. The dream of Hugo, St. Victor and Hegel of a history of consciousness can be realized on a no less broad basis. Such a system of philosophy and religion will rest on the narrow, shallow foundation of acuminated individual subjective thought, but will really consist of what is held to by all, always and everywhere.

This ideal invests even outlandish ideas of remote savage races with deep interest, inspired the long study of Buddhism made with the aid of personal intercourse with the pundits of Siam and Birmah, the results of which are presented in the author's works on the "Psychology of Buddhism" and his "Philosophy of Religion," and has made absence of system in his works cultivated as a virtue, because he holds that the true relation of these ideas to each other can only be found when they are all inductively gathered. The object of the present work is to show that modern spiritualistic and theosophic ideas are bequests of undeveloped savage races to the world of modern culture. As Jäger's idea of soul as something which is smelled is met with among many savage races (even animals whose sense of smell takes the place of sight in man perhaps believing in olfactory ghosts, Marville claiming to see in a magnifying glass that the exhalations of friends fused and those of enemies mutually repelled each other), so theosophy is but a recrudescence of a belief widely proclaimed in the twelfth century and held to in some form by many barbaric tribes. Spiritism and "esoteric Buddhism" illustrate the oldest and most widespread of popular superstitions against which Aristotle so vigorously protested, that the soul is something material, apprehensible to vision, smell, taste, touch, or audition, though finer and perhaps smaller than the body.

NOTES.

In an article on methods of investigation in psychology, in *Humboldt*, Jan., 1888, Professor Kraepelin, of Dorpat, expresses the opinion that the reason why the reign of law has been doubted in the realm of mind is found in wrong views about the nature of the freedom and spontaneity of the will. The idea was that the soul was a somatic attendant apart from the body which attention could observe as correctly at least as it can objects. From the very nature of attention, however, as now conceived, we can observe no psychic process or state of ourselves without a constant error. This latter is partially avoided by the memory method, which consists of turning the mind back upon the remembered image of a recent process. This is a more valuable method. Yet the memory image is always changed, lacks objective control, and so results vary with different individuals. This lack has been supplied by the experimental method, which arose in the field of physiology, but has already unfolded a wide field and numerous methods peculiar to itself. Experiment frees us from the deception of self-perception, and, beginning with the study of the simplest psychic processes of sense perception, is already grappling with the more central problems of attention, fatigue, habit, contrast, reproduction, association, morbid processes, and is even beginning to reach results about feeling and will of general validity like facts of other sciences. Those competent for self-analysis by older methods are so few and so peculiar that only the small part of the field representing certain coincident peculiarities has been worked over, and that only roughly, for exigencies of conduct, etc. The field of experimental psychology is far wider already, and what has been done is very little compared with what is to be expected in the future.

In viewing the well known stair figure of Schröder there is also an oscillation, and we seem now to be looking up under and now down upon the steps. The time of this oscillation was also found to be about the same as that for faint optical impressions above. In all such flickers of apprehension from concave to convex the real sensation does not change, but the "apperceptive organ," or, as Lange calls it, the memory image of previously seen stairs from above and below does. In assimilating the sensation the memory picture intensifies it. This act of active appropriation, according to the laws of association, or the mentalization of sensations, is what is called sensuous impression, and it is the memory pictures that vacillate. The vacillation time of memory pictures was also registered and found to agree with that of real sensation, being only a fraction of a second shorter for each sense. Active apperception, which intensifies impression, is possible only through voluntary motion. Concepts have a motor "hook" or else they cannot be pulled forth by active attention. The phenomenon of mental suggestion shows the existence of a motor element in memory pictures. In thinking of

an object of definite form with eyes closed, the eye-ball often moves, and Loeb has pointed out that the change of a concave image to a convex, and conversely, may be caused by accommodation. Acoustic images, too, are closely associated with tensions in the vocal apparatus. Thus probably we analyze the component parts of a note. Wolfe found tone memory was best after a period about equivalent to one wave of attention, and not, as we should *à priori* expect, immediately. The explanation of the relation between Lange's period and the period of most accurate reproduction of time intervals (.7 second), as determined by Estel and Mehner, is a very poor attempt to meet one of the gravest difficulties of his speculation.

A. Charpentier (*Centralblatt für Physiologie*, No. 2) has conducted a series of experiments upon the relation between the duration of very short retinal sensations and the minimum of illumination at which a sensation of light takes place. He corroborates the law announced by Bloch, that the minimum of illumination that is perceived by the eye is inversely proportional to the duration of the light impression; in other words, a very brief light impression must be proportionately intense to be perceived. A certain light mass (considered as the product of duration by intensity) is necessary for a light sensation, and the two components may have any values, the law strictly holding only for light impressions of less than one-eighth second. Charpentier also found that after remaining in a dark room the sensibility was increased, and that the color of those very rapid impressions (.006–.040 sec.) could not be perceived. In a second portion of the research he pierced holes in a rotating disk and measured the rate of rotation at which a continuous band of light was visible through the holes, as conditioned by the waning (Fortdauer) of the impressions. He concludes (1) that as the illumination increases the waning of the light sensation decreases; (2) that for weak illuminations and brief stimulations the waning of the sensation is nearly inversely as the square root of the illumination; (3) the waning of the sensation varies in an inverse sense with the duration of the stimulation; (4) the color of the light has no effect except as varying the illumination; (5) exposing the eye to a dark room acts like other causes of an increase in the sensation, in shortening the time during which the sensation retaining its initial intensity persists after the cessation of the stimulus. Bloch found that fatigue of the retina increased the time of waning of the sensation, but Charpentier finds a shortening of the time. J. J.

Dr. R. Berlin (*Centralblatt für Physiologie*, No. 2) describes under the name "dyslexia," a novel psychic affection related to "alexia," or word-blindness, but differing from it in that the patients can read a few lines, but apparently get no sense from their reading and give it up in despair. A number of post-mortem examinations of such cases locates the injury in the left hemisphere, and suggests the possibility of a lesion interfering with the function of the fibres connecting the articulation-centres in the inferior frontal convolution with the visual centres of the occipital lobe.

Dr. A. Nieden (*ibid.*) contributes a corrobatory case to Dr. Berlin's description of this "reading phobia." The symptoms developed in the patient subsequent to his first epileptic seizure, and consisted in an undefined aversion to reading more than a line or two. An

attempt to force him to read resulted in fainting fits, with perverse olfactory sensations. There were found three foci of degeneration in the lenticular-striate region, the second of which, lying in the subcortical fibres behind Broca's convolution, seems to be in connection with the above described symptoms.

An interesting test of the function of the feelers of insects has been made by offering the choice of two troughs as a highway to a number of roaches (küchenschaben), one of the troughs having been made redolent of stale cheese (very offensive to the roaches), and counting the number of individuals going over the two routes. Of thirty-six trials the odorous trough was decidedly avoided thirty times, the experiments being made in the dark. If, however, the feelers be cut off from the insects, about as many choose the odorous as the non-odorous trough, indicating that the feelers function as organs of smell. (Veit Graber in *Centralblatt für Physiologie*, No. 6.)

O. Tumlitz describes a simple method of demonstrating the chromatic aberration of the eye (*Centralblatt für Physiologie*, No. 8). A ring of platinum wire about 20 mm. in diameter is brought to white heat and viewed at about half a meter distance, through a minute hole in a screen that just allows the ring to be seen. The outer edge of the ring will then seem red, the inner bluish violet.

Vintschgau and Steinach (*Pflüger's Archiv*) have measured the reaction times for temperature from various parts of the skin. The mere feeling of contact is perceived considerably before the sensation of heat or cold, and on the forehead was perceived by Vintschgau in .119, and by Steinach in .107, second; on the right cheek in .119 and .101 second respectively; on the volar and dorsal surface of the left hand, .126 and .128 and .133 and .111 second. The results of their experiments with the time it takes to perceive heat and cold are given in the following table:

	Cold.		Heat.	
	Vintschgau. 2.2°-4.8° C.	Steinach. 2°-2.8° C.	Vintschgau. 48°-49° C.	Steinach. 45°-49° C.
Right temple,	.160	.116	.166	.132
Left temple,	.170	.124	.185	.138
Middle of forehead,	.143	.116	.144	.128
Right cheek,	.143	.114	.154	.117
Left cheek,	.151	.116	.158	.146
Volar surface of hand,				
(1) 2nd finger-joint,	.186	.152	.205	.173
(2) Near the ulnar aspect,	.206	.186	.208	.206
(3) On the ball of the thumb,	.185	.194	.251	.175
Dorsal surface of hand,				
(1) Near the ulnar aspect,	.208	.179	.246	.199
(2) Near the radial aspect,	.204	.170	.233	.196

These times show that the reaction to cold is somewhat quicker than to heat. Again, it was observed that if the stimulation be applied repeatedly to the same spot at short intervals, the reaction time is lengthened both for cold and for heat, though upon the cheek there was a lengthening of the time for cold but not for heat. Details are promised in a future paper.

Dr. Goldscheider (*Archiv für Anat. und Phys.* V) has been experimenting in the same direction. He applies a metal ball 15° C. for the cold stimulation and 50° C. for the warm, and reacts by a simple movement of the jaw. More than 2000 observations were recorded. The final averages in seconds are: for *cold*, near the edge of the eyelid, .135; on upper arm, .150; on abdominal surface, .226; on inner surface of thigh, .255. Corresponding times for the reaction to a sensation of warmth were: .190, .270, .620, .790. Here heat is considerably more slowly perceived than cold, and the difference is the greater the further removed the part of the skin is from the brain, amounting in the lower limbs to nearly half a second. If the stimulus is weak the time is much lengthened. A moderately warm stimulus on the arm was not reacted upon until after .46 to .54 second, and if very weak, .90 to 1.1 second. Care was taken to select equally sensitive spots in the various parts of the body, and this makes the explanation of the great difference between a stimulation far from and near to the brain still more difficult. The author offers no explanation, but does not accept the explanation that the sensation of heat passes slowly along the gray columns of the cord.

J. J.

Dr. Stanford E. Chaillé, of the Tulane University, gives in a summary article (*New Orleans Medical and Surgical Journal*, June, 1887) the typical stages of development of the infant, the reflexes, the senses, emotions, language, color, and especially the physical measurements. The child, he concludes, is not more pure and virtuous than adults, as is commonly supposed, but manifests in germ most of the bad traits of savagery. Goodness he regards not as innate, but the slow recent result of growth in age and civilization.

In the extended literature now accumulating on the opium habit, it is evident that at least dogs and apes not only fall victims to the habit, but are affected in a way very similar to man by the drug.

Bloch has experimented on the relative strength of sensations as inferred by the order in which two simultaneous sensations reach consciousness, and concludes that it takes $\frac{1}{72}$ of a second longer to hear a sound than to see a light, and that it takes $\frac{1}{21}$ of a second longer to feel a touch than to see a light. Thus the order of precedence in attracting attention would be sight, hearing, touch.

An interesting addition to the material collected in W. G. Black's *Folk-medicine* is made in Mr. James Mooney's paper on the "Medical Mythology of Ireland," where we are told the superstitions described are living realities.

Messrs. E. H. S. Bailey and E. L. Nichols (*Science*, March 23) give an account of some interesting determinations of the sensibility of the sense of taste for the different classes of tastes. The method consisted in having dilute solutions of various strengths, and containing quinine if bitter was to be aroused, cane sugar for sweet, sulphuric acid for acid, sodium bicarbonate for alkaline, and sodium chloride for saline, and in requiring the person tested to arrange these substances according to their taste. Their results, founded upon the observation of 128 persons, 82 male and 46 female, are expressed in the following table:

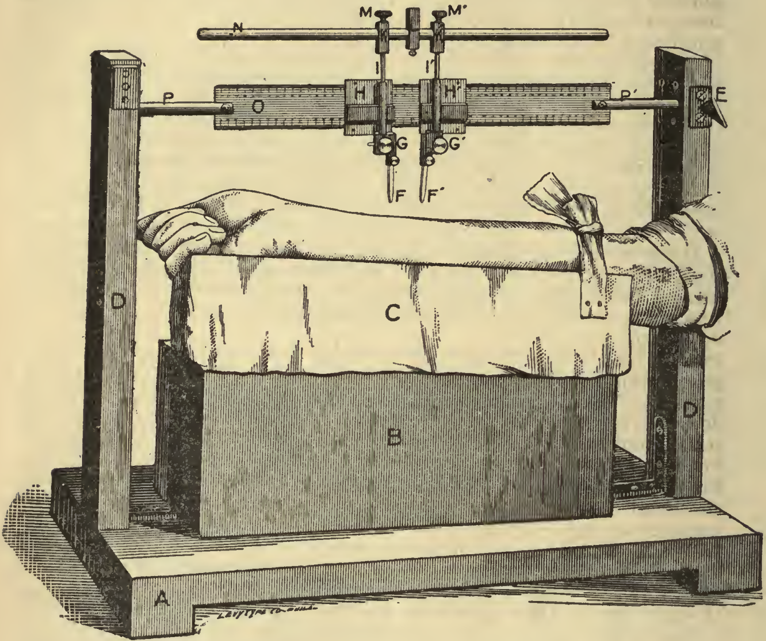
Substances.	Male observers detected	Female observers detected
Quinine....................	One part in 392 000	One part in 456 000
Sugar	" " 199	" " 204
Acid	" " 2 080	" " 3 280
Soda	" " 98	" " 126
Salt	" " 2 240	" " 1 980

From this they conclude that (1) the sense for bitter is vastly more delicate than for any other class, it being possible to detect quinine in a solution only $\frac{1}{2000}$ the strength that a sugar solution must have to be tasted; (2) that the order of delicacy is bitter, acid, salt, sugar, and alkali; and (3) that the sense of taste is more delicate in women than in men. This last is peculiar, because these experimenters had previously shown the sense of smell to be more delicate in men. They also note that wide individual differences presented themselves (as much as in the ratio of one to three), and that these variations were not explicable as results of education, men with great experience in handling drugs being surpassed by women without any such training. In a few cases the ability to detect a dilute sweet was accompanied by an inability to detect dilute bitter. J. J.

Dr. Wm. Noyes, in the *Journal of Social Science*, 1888, 1, gives a very convenient summary of the modern view of the criminal, following in the main the ideas of Lombroso. The distinction of the criminal from his normal fellow-men by physical and psychical abnormalities, many of which indicate a reversion to a more primitive type, forms the chief point in the address. So little of this Italian movement has been presented in English that the above paper is especially welcome.

The Collége de France has just transformed the chair of "The Law of Nature and of Nations" into a chair of "Experimental Psychology," and has called M. Th. Ribot, editor of the *Revue Philosophique* and a well known popular writer upon psychological topics, to the chair. In an article occasioned by this action, M. Janet (*Rev. de Deux Mondes*, April 1, 1888) surveys the various lines of interest that the new psychology embraces. It is wider than physiological psychology and includes the consideration of the morbid manifestations of mind, the minds of the lower animals, of children, and of savages. It is experimental and comparative in its methods, and aims to create a psychology that is abreast of modern science and does justice to all the various phases of the topic. He refutes the notion that the new science is not ready to be taught, as well as the notion that it is "materialistic" in its tendencies. The representatives of the scientific movement have not claimed that theirs is the only aspect of philosophic problems; they have as a rule held the very opposite of materialistic notions, and they are characterized by a spirit of good will and co-operation towards all workers in the field that was lamentably absent from philosophic discussions in the past. M. Ribot in his opening address takes a survey of the activity in matters psychological in the chief European countries and in America, and is able to draw a very hopeful picture indeed. Everywhere is the scientific method being introduced, facts preferred to speculations, and contributions to one or other of the many rubrics of psychology made. Psychological laboratories are spreading, and the day seems not far distant when this science will take recognized place on the curricula of all institutions for the higher education.

The accompanying cut illustrates a new aesthesiometer designed by Dr. Joseph Jastrow, of the Johns Hopkins University. The essential parts of the instrument are as follows: A base, *A*, to which is



attached a pair of uprights, *D D'*; a block, *B*, upon which rests a frame, *C*, for receiving the arm which is held in position by grasping the band as shown in the cut. A fine millimeter-scale, *O*, with two arms, *P P'*, through which it is fastened at *E* at any desired angle. Upon this scale are two carriages, *H H'*, sliding along it with as much or as little friction as is desired. At *G* there is a small "knee" that can be firmly screwed and holds the points, etc., *F F'*; any number and size of these knees can be made. Above are two rods, *I I'*, connected with two head pieces, *K K'*, through which passes a steel rod, *N*. The carriage is held in a fixed position by screwing down the screws at *M M'*, and the two points are made to touch the skin by pressing the button at *L*, which presses down a spring that in turn releases the points. The stand and accessory appliances are of wood, the rest of brass and steel. The length of the scale *O* is 30 decimeters. The instrument is intended to supplant the use of the compass-points held in the hand, and by the numerous variations of the points, etc., allows of a more convenient and accurate application. The points of improvement to which attention is called are the following: (1). The points are no longer held in the hand but are firmly mounted. We are thus sure that the two will touch at once and with equal intensity; the contact is the same one time as the next, and

the time of contact can be regulated. (2). The distance between the points is easily set and accurately measured. (3). The points can be applied at any angle so that, *e. g.*, one can experiment upon the forehead or back with the subject in a normal sitting posture. (4). The points can be used singly by drawing out the rod *N*, and any number of points can be used. (5). The points can be applied to any part of the body by having a suitable support. (6). By using a double apparatus, two pairs of points can be applied to the same points on the skin, or simultaneously on symmetrical portions. (7). Points of any kind can be inserted—type, rods, or other patterns. (8). The points can be moved continuously along the skin, and thus used for mapping out "hot" and "cold points." (9). By making electrical connections the reaction time for touch can be measured.

HYPNOTISM AMONG THE ESKIMO.—Capt. Healy, in his last report of the cruise of the Corwin, reports a most singular performance resembling a spiritualistic *séance*. The wife of one of the natives, an old hag of 60, was observed to drop suddenly on the ground. Her lips were blue, her teeth were set hard together, while her labored breathing produced a light froth from her lips. The eyes were closed, the pupils much contracted, and the whole appearance of the eye expressionless. Her husband immediately ran to her, passed a stout deerskin thong around her head, and secured it to the end of a stout staff about 6 feet in length. He then sat down near the woman's head and brought the staff across his thighs, making a lever of the first kind. Then he began in a chanting tone to speak to a spirit of the dead concerning his probable success during the approaching hunting season. When a question was to be answered he paused and tried to lift the woman's head from the ground. If he succeeded it meant yes; if not, the contrary answer was inferred. The performance went on some time, and such force was used by the man that the poor creature's head was in danger.

During the *séance* the man had his rifle and hunting knife brought and placed near by to ascertain their qualities. When the questioning ceased the thong was removed from the woman's head, and with a few passes exactly similar to those used by mind readers, the woman was restored to consciousness. For a while she seemed dazed and unsteady, but soon commenced to narrate what she had seen in the trance. She claimed to have been far away in a deer country, to have seen relatives and friends of those present, who listened with rapt attention, and with the appearance of perfect confidence in her veracity, to the messages and news which she brought them. This happened at the mouth of Kowak river in Kotzebue Sound, Alaska, in August, 1885. O. T. MASON.

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A FURTHER STUDY OF HERACLITUS.

G. T. W. PATRICK, PH. D.

Preface.

The latest writers on Heraclitus, namely, Gustav Teichmüller and Edmund Pfleiderer, have thought it necessary to preface their works with an apology for adding other monographs to the Heraclitic literature, already enriched by treatises from such distinguished men as Schleiermacher, Lassalle, Zeller, and Schuster. That still other study of Heraclitus, however, needs no apology, will be admitted when it is seen that these scholarly critics, instead of determining the place of Heraclitus in the history of philosophy, have so far disagreed, that while Schuster makes him out to be a sensationalist and empiricist, Lassalle finds that he is a rationalist and idealist. While to Teichmüller, his starting point and the key to his whole system is found in his physics, to Zeller it is found in his metaphysics,

and to Pfleiderer in his religion. Heraclitus' theology was derived, according to Teichmüller, from Egypt; according to Lassalle, from India; according to Pfleiderer, from the Greek Mysteries. The Heraclitic flux, according to Pfleiderer, was consequent on his abstract theories; according to Teichmüller, his abstract theories resulted from his observation of the flux. Pfleiderer says that Heraclitus was an optimist; Gottlob Mayer says that he was a pessimist. According to Schuster he was a hylozoist, according to Zeller a pantheist, according to Pfleiderer a panzoist, according to Lassalle a panlogist. Naturally, therefore, in the hands of these critics, with their various theories to support, the remains of Heraclitus' work have suffered a violence of interpretation only partially excused by his known obscurity. No small proportion of the fragments, as will be seen in my introduction, have been taken in a diametrically opposite sense.

Recently a contribution towards the disentanglement of this maze has been made by Mr. Bywater, an acute English scholar. His work (Heracliti Ephesii Reliquiae, Oxford, 1877) is simply a complete edition of the now existing fragments of Heraclitus' work, together with the sources from which they are drawn, with so much of the context as to make them intelligible.

Under these circumstances I have thought that a translation of the fragments into English, that every man may read and judge for himself, would be the best contribution that could be made. The increasing interest in early Greek philosophy, and particularly in Heraclitus, who is the one Greek thinker most in accord with the thought of our century, makes such a translation justifiable, and the excellent and timely edition of the Greek text by Mr. Bywater makes it practicable.

The translations both of the fragments and of the context are made from the original sources, though I have followed the text of Bywater except in a very few cases, designated in the critical notes. As a number of the fragments are ambiguous, and several of them contain a play upon words, I have appended the entire Greek text.

The collection of sources is wholly that of Mr. Bywater. In these I have made a translation, not of all the references, but only of those from which the fragment is immediately taken, adding others only in cases of especial interest.

My acknowledgments are due to Dr. Basil L. Gildersleeve, of the Johns Hopkins University, for kind suggestions concerning the translation, and to Dr. G. Stanley Hall for valuable assistance in relation to the plan of the work.

INTRODUCTION.

SECTION I.—HISTORICAL AND CRITICAL.

Modern Heraclitic literature belongs wholly to the present century. The most important works are the following:—Schleiermacher: Herakleitos, der Dunkle von Ephesos, in Wolf and Buttmann's Museum der Alterthumswissenschaft, Vol. I, 1807, pp. 313–533, and in Schleiermacher's Sämmt. Werke, Abth. III, Vol. 2, Berlin, 1838, pp. 1–146;—Jak. Bernays: Heraclitea, Bonn, 1848; Heraklitische Studien, in the Rhein. Mus., new series, VII, pp. 90–116, 1850; Neue Bruchstücke des Heraklit, ibid. IX, pp. 241–269, 1854; Die Herakliticshen Briefe, Berlin, 1869;—Ferd. Lassalle: Die Philosophie Herakleitos des Dunkeln von Ephesos, 2 vols., Berlin, 1858;—Paul Schuster: Heraklit von Ephesus, in Actis soc. phil. Lips. ed. Fr. Ritschelius, 1873, III, 1–397;—Teichmüller, Neue Stud. z. Gesch. der Begriffe, Heft I, Gotha, 1876, and II, 1878;—Bywater: Heracliti Ephesii Reliquiae, Oxford, 1877;—Edmund Pfleiderer: Die Philosophie des Heraklit von Ephesus im Lichte der Mysterienidee, Berlin, 1886;—Eduard Zeller: Die Philosophie der Griechen, Bd. I, pp. 566–677.

There may be mentioned also the following additional writings which have been consulted in the preparation of these pages:—Gottlob Mayer: Heraklit von Ephesus und Arthur Schopenhauer, Heidelberg, 1886; Campbell: Theaetetus of Plato, Appendix A, Oxford, 1883; A. W. Benn: The Greek Philosophers, London, 1882.

After the introductory collection and arrangement of the Heraclitic fragments by Schleiermacher, and

the scholarly discriminative work and additions of Bernays, four attempts have been made successively by Lassalle, Schuster, Teichmüller, and Pfleiderer, to reconstruct or interpret the philosophical system of Heraclitus. The positions taken and the results arrived at by these eminent scholars and critics are largely, if not wholly, different and discordant. A brief statement of their several positions will be our best introduction to the study of Heraclitus at first hand, and at the same time will offer us incidentally some striking examples of prevalent methods of historic criticism.

One of the greatest evils in circles of philosophical and religious thought has always been the evil of *over-systemization.* It is classification, or the scientific method, carried too far. It is the tendency to arrange under any outlined system or theory, more facts than it will properly include. It is the temptation, in a word, to classify according to resemblances which are too faint or fanciful. In the field of historic criticism this evil takes the form of *over-interpretation.* Just as in daily life we interpret every sense perception according to our own mental forms, so we tend to read our own thoughts into every saying of the ancients, and then proceed to use these, often without dishonesty, to support our favorite modern systems. The use of sacred writings will naturally occur to every one as the most striking illustration of this over-interpretation. Especially in the exegesis of the Bible has this prostitution of ancient writings to every man's religious views been long since recognized and condemned, and if most recently this tendency has been largely corrected in religious circles, it is all the more deplorable, in philosophical criticism, to find it still flourishing.

Unfortunately, this vice continues, and it appears nowhere more plainly than in the interpretation of Greek philosophy. There is a great temptation to modern writers to use the Greek philosophers as props to support their own systems—a temptation to interpret them arbitrarily, to look down upon them patronizingly, as it were, showing that what they meant was this or that modern thought, having only not learned to express themselves as well as we have. Among historians of philosophy this appears as a one-sidedness, so that it is commonly necessary in reading a history of philosophy to make a correction for the author's "personal equation." The histories of Schwegler and of Lewes are examples—the one biased by Hegelianism, the other by Positivism. Undoubtedly, a certain personal equation is unavoidable, and it is as impossible for an interpreter of Greek philosophy to make himself wholly Greek as it is unfair to represent the ancient thinker as wholly German or English. But when this becomes complete one-sidedness, or blindness to all but one series of an author's thoughts, or a willful or even unintentional perversion of his words, vigorous remonstrance is called for.

This attempt to fully understand the ancients, to make them speak in the phraseology of some modern school, must be distinguished from the recent movement, represented by Prof. Lagarde and others, in interpreting historic thought and historic events psychologically. This movement is certainly legitimate, based as it is on the truth of the similarity of constitution of all human minds, and the probability that underlying all representative historic creeds are great related if not identical thoughts. Even here, of course, the attempt to express these thoughts in the set phrases of any one people is inadequate.

We proceed, then, to look at some of the work done upon the philosophy of Heraclitus. Here we shall not attempt any examination of Zeller's exposition, since his work, though it is perhaps the very best that has been done in this field, is critical rather than reconstructive, and like his whole history of Greek philosophy, is a marvel of candor as well as of immense research. Even Zeller, however, has not wholly escaped the charge of one-sidedness, since Benn, in the preface to his work on the Greek philosophers, has accused him of never having outgrown the semi-Hegelian prejudice of his youth.

Lassalle.

Lassalle, in two ponderous volumes noted above (page 560), made the first and most elaborate attempt to reconstruct the system of the Ephesian philosopher. His work exhibits immense labor and study, and extended research in the discovery of new fragments and of ancient testimony, together with some acuteness in their use. Lassalle has a very distinct view of the philosophy of Heraclitus. But it is not an original view. It is, in fact, nothing but an expansion of the short account of Heraclitus in Hegel's History of Philosophy, although Lassalle makes no mention of him, except to quote upon his title-page Hegel's well-known motto, "Es ist kein Satz des Heraklit, den ich nicht in meine Logik aufgenommen." Hegel's conception of Heraclitus is, in a word, as follows: Heraclitus' Absolute was the unity of being and non-being. His whole system was an expansion of the speculative thought of the principle of pure becoming. He apprehended, and was the first to apprehend, the Absolute as a *process*, as the unity of opposites, as dialectic

itself. His great contribution was the speculative transition from the being of the Eleatics to the idea of becoming. Now how does Hegel support this position? There is in his Logic but one passage referring to Heraclitus. There he says, "Glancing at the principle of the Eleatics, Heraclitus then goes on to say, 'Being no more is than non-being' (οὐδὲν μᾶλλον τὸ ὂν τοῦ μὴ ὄντος ἐστὶ), a statement expressing the negative nature of abstract being and its identity with non-being" (Wallace, The Logic of Hegel, p. 144; cp. Science of Logic, Hegel's Werke, Vol. 3, p. 80). Hegel omits, in the Logic, to give the reference to the above quotation, but in his History of Philosophy (Werke, Vol. 13, p. 332) he quotes the same passage with the reference. It is to Aristotle, Metaph. i. 4. We turn to the same and find that it is a passage which Aristotle quotes from the Atomists, Democritus and Leucippus, and that it has not the slightest reference to Heraclitus, who, indeed, is not mentioned in the same chapter. This is rather discouraging, but the account in the History of Philosophy, to which we now turn, is scarcely less so. There Hegel begins his exposition of Heraclitus as follows:

"1. Das allgemeine Princip. Dieser kühne Geist (Heraclitus) hat zuerst das tiefe Wort gesagt, 'Das Seyn ist nicht mehr als das Nichtseyn,' es ist ebenso wenig, oder, 'Seyn und Nichts sey dasselbe,' das Wesen sey die Veränderung" (Gesch. d. Phil. Vol. 13, p. 332).

Now it happens that Heraclitus said nothing of the kind. As references Hegel gives Aristotle, Metaphys. i. 4; iv. 7; iv. 3. The first passage, as we have already seen, is from the Atomists. The second turns out upon examination to be simply the expression,

"All things are and are not" (πάντα εἶναι καὶ μὴ εἶναι), and the third is a statement of Aristotle that some people supposed Heraclitus to have said that the same thing could both be and not be the same. Moreover, neither of these passages is Heraclitic in form, and they are not even mentioned in Bywater's edition. The only expression of Heraclitus that resembles in form the above passage from Aristotle is that of frag. 81, "Into the same river we step and we do not step. We are and we are not." The over-interpretation by which this simple passage, expressing incessant physical *change*, is transformed into the logical principle of Hegel, "Das Seyn ist nicht mehr als das Nichtseyn," "Seyn und Nichts sey dasselbe," is audacious at least. Furthermore, we may say here in passing, that neither the expressions τὸ ὄν, μὴ ὄν, nor even τὸ γιγνόμενον, occur in any genuine saying of Heraclitus; although if they did occur, it would be easy to show that they could not mean at all what Hegel meant by being, non-being, and becoming. Even the Eleatic Being was not at all the same with that of Hegel, but was finite, spherical, and something very much like that which we should call material. But Heraclitus, who indeed preceded Parmenides, said nothing of being nor of non-being, nor did he speak of becoming in the abstract, although the trustful reader of Hegel, Lassalle, or Ferrier, might well suppose he spoke of nothing else. That which these writers mistook for becoming was, as we shall see later, only physical *change*. With the loss of this corner-stone, the Heraclitic support of the Hegelian Logic fails, and Hegel's boast that there was no sentence of Heraclitus that his Logic had not taken up becomes rather ludicrous, especially if one will read through the remains of

Heraclitus' work on Nature and search for his rich and varied thoughts in the Logic of Hegel.

Returning now to Lassalle, the above principles are carried out more in detail as follows: The chief point in the philosophy of Heraclitus is that here first the formal notion of the speculative idea in general was grasped. With him first emerged the conception of pure thought defecated of the sensuous. His ground principle was the dialectical opposition of being and non-being. The kernel and whole depth of his philosophy may be expressed in the one sentence, "Only non-being is" (Lassalle, Vol. 1, p. 35). The unity of being and non-being is a unity of process (processirende Einheit). It is the unity of opposites, the idea of becoming, the divine law, the γνώμη of the determining God (Id. Vol. 1, p. 24). Fire, strife, peace, time, necessity, harmony, the way up and down, the flux, justice, fate, Logos, are all different terms for this one idea (Id. Vol. 1, p. 57). Hence arises Heraclitus' obscurity. It is not a mere grammatical obscurity, as Schleiermacher, following Aristotle (Rhet. iii. 5, p. 1407, b. 14) thought; nor is it a willful obscurity, but it arises from the very nature of his great thought, which could not be enunciated in exact terms, but could only be suggested by such words as fire, time, etc., and so he labored on with one new symbol after another, vainly trying to express himself.

The Heraclitic fire is a "metaphysical abstraction"—a pure process, "whose existence is pure self-annulling (sich aufheben), whose being is pure self-consumption (sich selbst verzehren)" (Lassalle, Vol. 1, p. 18).

Most clearly, however, is the great thought of Heraclitus shown in "the way up and down," which does not involve change of place, but only a logical process.

It is "nothing else" than the change from being into non-being and the reverse. The way down is transition into being; the way up is the return into the pure and free negativity of non-being, motion in the undisturbed ideal harmony (Id. Vol. 2, p. 241 ff.).

God, in his adequate form, is "nothing else" than pure negativity, the pure unity of process of opposites. Nature is only the corporeal manifestation of the law of the identity of opposites. It owes its existence to privation (ἀδίκια), that is, to the injustice which pure becoming suffers when it becomes being (Id. Vol. 1, p. 138).

The ἀναθυμίασις of Heraclitus is not any vapor or sensible exhalation, but is "nothing else" than the way up, or the ἐκπύρωσις, that is, the cessation of the sensible and the particular and the assumption of the real universal becoming. 'Αναθυμιωμέναι, Lassalle says, should be translated "processirend" (Id. Vol. 1, p. 144).

The Heraclitic flux is the same as the way up and down. It is the dialectic of spacial being; it is the unity of being and non-being as spacial; it is the here which is not here. The περιέχον of Heraclitus is not anything physical or spacial, but "the universal real process of becoming," which works through the Logos or law of thought (Id. Vol. 1, p. 306).

The Heraclitic Logos is the pure intelligible logical law of the identity in process (die processirende Identität) of being and non-being. It is "nothing else" than the law of opposites and the change into the same (Id. Vol. 1, p. 327; Vol. 2, p. 265).

The substance of the soul is identical with the substance of nature. It is pure becoming which has incorporated itself, embraced the way down. The dry or fiery soul is better than the moist because moisture

is "nothing else" than a symbol of the downward way. The soul that is moist has descended out of its pure self-annulling movement or negativity in process, into the sphere of the particular and determinate (Id. Vol. 1, pp. 180, 192).

Heraclitus, in his desperate labor to express this idea, enters the sphere of religion. Dionysus and Hades are the same, he says (see frag. 127). That is, says Lassalle, Dionysus, the god of generation which represents the descent of pure non-being into being, is identical with Hades, the god of death; and this fragment, which is a polemic against Dionysus, is really a polemic against being, which is inferior to non-being (Id. Vol. 1, p. 208).

Knowledge consists in the recognition in each particular thing of the two opposites which constitute its nature (Id. Vol. 2, p. 272). Of ethics, the formal principle is self-realization or self-representation. It is the realization of what we are in ourselves or according to our inner nature. The ideal is separation from the sensible and particular and the realization of the universal (Id. Vol. 2, p. 428 ff.).

Such in brief outline is what Ferdinand Lassalle finds in Heraclitus' book On Nature. As an exposition of Heraclitus it is not worth the space we have given it, or any space, in fact; but as one of the most beautiful illustrations of over-systemization, it is extremely valuable. Any formal refutation of his conception of Heraclitus is unnecessary, for almost the whole of it is without any foundation whatever. The expositions which are to follow, or even a slight reading of the fragments themselves, will sufficiently show how thoroughly fantastic and arbitrary are his interpretations. Lassalle seems to have been misled partly by Hegel's

misinterpretation of the passages from Aristotle noticed above, and partly by the principle of opposition which runs through a number of the sayings of Heraclitus—an opposition which, as we shall see later, was wholly physical, and far more simple than the abstruse logical meaning given it by Lassalle. This German scholar had no power or no wish to put himself in the attitude of the Greek mind, which was as widely different from his as possible. It was a mistake for this disciple of pure thought, bred in the stifling atmosphere of a nineteenth century Hegelian lecture-room, and powerless to transport himself out of it even in thought, to attempt to interpret the sentences of an ingenuous lover of Nature, who, five centuries before the Christian era, lived and moved in the free air of Ephesus. In this we do not mean to say that the philosophy of Heraclitus was purely physical rather than metaphysical, for we shall see that such was not the case, but primitive pre-Socratic metaphysics and the panlogism of Lassalle are as wide asunder as the poles. On this point, Benn, in the work already referred to, well says, "The Greek philosophers from Thales to Democritus did not even suspect the existence of those ethical and dialectical problems which long constituted the sole object of philosophical discussion" (Vol. 1, p. 4).

Those who wish to trace Lassalle's errors further may compare, on his mistaken conception of the Heraclitic fire, Zeller, Vol. 1, p. 591, 3[1]; Grote: Plato, Vol. 1, p. 33, note. On "the way up and down," compare Zeller, Vol. 1, p. 619, 1. On the flux, compare Schuster, p. 201; Zeller, Vol. 1, p. 577, 1.

The characterization of Lassalle's book as a whole

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[1] The references to Zeller in the following pages are to the fourth German edition of Die Philosophie der Griechen.

is, that it is a striking example of great philosophic waste, turning as he does the rich and suggestive philosophy of the Ephesian into a wretched mouthful of Hegelian phrases. His citation of so many diverse sentences of Heraclitus, drawn from theology, ethics, nature, and man, and his discovery in all of them of his single ever-recurring notion of "die reine umschlagende Identität von Sein und Nichtsein," impresses us with the power which the tyranny of a single idea may have to so blur one's vision as to cause him to see that idea reflected in everything that is presented. It is not true, as Lassalle's motto goes, that there is no sentence of Heraclitus that Hegel has not incorporated in his Logic, but it is not far from the truth that there is no sentence of Heraclitus which Hegel and Lassalle have not either willfully or ignorantly perverted.

Schuster.

We will mention now the work of Paul Schuster (see above, p. 560). Schuster approaches the problem of the interpretation of Heraclitus with the advantage of a rich philological and historical knowledge. He suffers a disadvantage, however, in the magnitude of the task he undertakes, which is nothing less than the reconstruction of the order and plan of the book of Heraclitus itself. The interpretation of the fragments, he justly observes, depends upon the connection in which they occurred. It will be necessary, therefore, if we will grasp their true sense, to recover the plan of the original writing. Such a reconstruction Schuster holds to be possible, since by the law of selection, the fragments which have been preserved to us must have been the central thoughts of the original work. Contrary to Schleiermacher, he accepts as trustworthy the

statement of Diogenes (Diog. Laert. ix. 5) that the book of Heraclitus was divided into three parts or Logoi, the first concerning "the all," the second political, the third theological. On this basis Schuster arranges the fragments, freely translated or rather paraphrased, and interspaced with the restored progress of thought. The well known obscurity of our philosopher, Schuster, contrary to all other critics except Teichmüller, supposes to have been partly, at least, intentional, as a precaution against persecution for atheism.[1]

The distinctive feature of Schuster's conception of Heraclitus is that he was not a distruster of the senses, but on the contrary the first philosopher who dared to base all knowledge upon sense experience. He was therefore the first of experimental philosophers. To this idea the introduction of Heraclitus' book was devoted. The majority of people, says the Ephesian, have little interest in that which immediately surrounds them, nor do they think to seek for knowledge by investigation of that with which they daily come in contact (Clement of Alex. Strom. ii. 2, p. 432; M. Aurelius iv. 46; cp. frags. 5, 93). Nevertheless, that which surrounds us is the source of knowledge. Nature is not irrational and dumb, but is an ever living Voice plainly revealing the law of the world. This Voice of Nature is the Heraclitic Logos. The thought which Heraclitus utters in the passage standing at the beginning of his book (frag. 2, Hippolytus, Ref. haer. ix. 9; cp. Aristotle, Rhet. iii. 5, p. 1407, b. 14) is no other than that which since the Renaissance has

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[1] Compare Plutarch. Pyth. orac. 21, p. 404; = frag. 11; Clement of Alex. Strom. v. 13, p. 699; = frag. 116. The numbers refer not to Schuster's numbering of the fragments, but to that of the present work, which is the numeration of Bywater.

inspired natural science and its accompanying speculation, namely, that truth is to be won by observation of the visible world. But the people, he complains, despise the revelation which Nature offers us with audible voice. Why, asks Heraclitus (Hippolytus, Ref. haer. ix. 9; cp. frag. 47), should an invisible harmony be better than a visible? It is not better, but, on the contrary, whatever is the object of seeing, hearing, or investigation, that I particularly honor (idem ix. 10; cp. frag. 13). Men, therefore, must trust their eyes (Polybius, xii. 27; cp. frag. 15) and not make reckless guesses concerning the weightiest things (Diog. Laert. ix. 73; cp. frag. 48). That Heraclitus' theory of knowledge, therefore, based it upon sense perception and reflection thereupon, is shown, continues Schuster, not only by the above passages, but also by the fact that the exaggerated form of the theory held by Protagoras (cp. Plato's Theaetetus) must necessarily have had its source in Heraclitus, his master. None the less is this shown also by Parmenides' attack on the empirical theory of knowledge (Sextus Empir. vii. 3), which could have been aimed only at the philosopher of Ephesus (Schuster, pp. 7 and 13–42).

Turning now from the theory of knowledge to its results, the first law which the observation of Nature teaches us is the law of eternal and recurrent motion (*πάντα χωρεῖ καὶ οὐδὲν μένει*, Plato, Crat. p. 402 A). The starting point and central position of our philosopher we must find in this recurrent motion, rather than in the primitive fire which itself held a subordinate place in the system. But the Heraclitic motion was not conceived as any absolute molecular change in the modern sense, nor yet as that absolute instability which appeared in the nihilism of the later

Heracliteans. It was rather conceived in a simpler way, as a general law that everything comes to an end and there is nothing permanent. Under this was included : 1) spacial motion, as of the flowing river; 2) qualitative change, as in the human body; 3) a kind of periodicity which brings everything under its dominion. The last was the most emphasized. Birth and death are universal; nothing escapes this fate. There is no fixed or unmoved being above or outside the shifting world, no divine heavenly existence that does not change, but all is involved in the same perpetual ebb and flow, rise and fall, life and death (Schuster, p. 81 ff.).

But this life and death of the universe is literal, not figurative. The world itself is a great living organism subject to the same alternation of elemental fire, air, and water. This thoroughgoing hylozoism which Schuster attributes to Heraclitus, he bases principally on the writing *de diaeta* of Pseudo-Hippocrates, who, he believes, made a free use of the work of Heraclitus, if he did not directly plagiarize from him. Comparing this writing (particularly the passage, c. 10, p. 638) with Plato's Timaeus (p. 40 A, also drawn from Heraclitus), he ventures to reconstruct the original as follows : "Everything passes away and nothing persists. So it is with the river, and so with mortal beings; in whom continually fire dies in the birth of air, and air in the birth of water. So also with the divine heavenly existence, which is subject to the same process, for we are in reality only an imitation of that and of the whole world; as it happens with that so it must happen with us, and inversely we may judge of that by ourselves" (Schuster, p. 118).

The life principle of the universe, as of the human

organism, is fire. This fire is everywhere present, so that "everything is full of gods and souls" (Diog. Laert. ix. 7). The life of the body is sustained by the breath which inhales the dry vapors kindred to fire. At night, when the sun is extinguished and the world becomes unconscious, we inhale the dark wet vapors and sink into death-like sleep (Schuster, p. 135).

The sun, which is new every day, changes at night into the surrounding air and then into the water of the sea. The sea produces the daily sun, as it is the source of all earthly phenomena. On a large scale this threefold change takes place with the universe, which will ultimately be consumed in fire, again to become sea and cosmos. This is "the way up and down"—not a circular movement of the elements within the cosmos (Zeller), but the periodicity of the world itself. The way up and the way down relate only to the cosmogony. The latter is the creation of the world by condensation of fire into water, then earth; the former is the reverse process of vaporization (Id. p. 169).

This law or order is not dependent upon any divine purposeful will, but all is ruled by an inherent necessary "fate." The elemental fire carries within itself the tendency toward change, and thus pursuing the way down, it enters the "strife" and war of opposites which condition the birth of the world (*διακόσμησις*), and experience that hunger (*χρησμοσύνη*) which arises in a state where life is dependent upon nourishment, and where satiety (*κόρος*) is only again found when, in pursuit of the way up, opposites are annulled, and "unity" and "peace" again emerge in the pure original fire (*ἐκπύρωσις*). This impulse of Nature towards change is conceived now as "destiny," "force," "necessity," "justice," or, when exhibited

in definite forms of time and matter, as "intelligence" (Id. p. 182, 194 ff.).

The Heraclitic harmony of opposites, as of the bow and the lyre, is a purely physical harmony. It is simply the operation of the strife of opposite forces, by which motion within an organism, at the point where if further continued it would endanger the whole, is balanced and caused to return within the limits of a determined amplitude (Id. p. 230 ff.).

The identity of opposites means only that very different properties may unite in the same physical thing, either by simultaneous comparison with different things or successive comparison with a changeable thing (Id. pp. 236, 243).

The second or political section of Heraclitus' work treated of arts, ethics, society, and politics. It aimed to show how human arts are imitations of Nature, and how organized life, as in the universe and the individual, so in the state, is the secret of unity in variety. The central thought was the analogy existing between man and the universe, between the microcosm and the macrocosm, from which it results that the true ethical principle lies in imitation of Nature, and that law is founded on early customs which sprang from Nature (Id. p. 310 ff.).

The third or theological section was mainly devoted to showing that the names of things are designations of their essence. That Heraclitus himself, not merely his followers, held the *φύσει ὀρθότης ὀνομάτων*, and used etymologies as proofs of the nature of things, Schuster believes is both consistent with his philosophy and conclusively proved by Plato's Cratylus. Primitive men named things from the language which Nature spoke to them; names, therefore, give us the truth of

things. Etymologies of the names of the gods was the proof first brought forward, as in Plato's Cratylus; hence the name of this section of the work. To show this connection of names and things was to prove the intimate connection of man with Nature, and so to lead to the conclusion that all knowledge is based on experience, which, indeed, was the end he had in view (Id. p. 317 ff.).

It is not our purpose to criticize in detail Schuster's conception of Heraclitus. Much of it will commend itself to the careful student of the remains, particularly that which relates to the Heraclitic flux and its relation to the primitive fire. Suggestive, also, if not unimpeachable, is his conception of the relation of the microcosm to the macrocosm, and of the harmony and identity of opposites. In his exposition of these doctrines, Schuster has rendered valuable service. We can by no means, however, allow thus tentatively to pass, Schuster's conception of Heraclitus as a purely empirical philosopher. Before noticing this, a word needs to be said in regard to Schuster's method as a whole. As to the latter, the very extent of the task proposed made over-systemization inevitable. In criticism of Schuster's attempt, Zeller has well said that with the extant material of Heraclitus' book, the recovery of its plan is impossible (Vol. 1, p. 570, note). Such a plan of reconstruction as that which Schuster undertakes, demands the power not only to penetrate the sense of every fragment, but also so to read the mind of the author as to be able to restore that of the large absent portions. The small number and enigmatical character of the fragments which are extant, together with the contradictory character of ancient testimony to Heraclitus, makes such a task extremely hazardous.

It can be carried through only by the help of "unlimited conjecture." Such conjecture Schuster has used extensively. The necessity of carrying through his plan has led him to find in some passages more meaning than they will justly bear, while his apparently preconceived notion as to the wholly empirical character of the system has led him to distort the meaning of many sentences. We shall see examples of this presently. Incidentally, his method may be illustrated by his connection and use of the two passages: *ἀνθρώπους μένει ἀποθανόντας, ἅσσα οὐκ ἔλπονται οὐδὲ δοκέουσι* (Clement of Alex. Strom. iv. 22, p. 630; cp. frag. 122), and *αἱ ψυχαὶ ὀσμῶνται καθ' ᾅδην* (Plutarch, de Fac. in orbe lun. 28, p. 943; cp. frag. 38). Schuster conjectures that these passages came together in the original work, and he renders and interprets them as follows: "There awaits men in death what they neither hope nor believe," namely, rest and the joy of a sleep-like condition (!), so that even instinctively "souls scent out death," desiring to obtain it (Schuster, p. 190). Not to speak of the forced translation of the latter fragment, only the most vivid imagination would think of using these passages in this way, especially as Clement himself, in his use of the first passage, refers it to the punishments which happen to men after death (see below, frags. 122 and 124, sources), and Plutarch, in respect to the second, uses it as proof that souls in Hades are nourished by vapors (see below, frag. 38, sources). But Schuster's conception of Heraclitus did not admit of belief in a distinct life after death, and it was necessary to make these passages fit in with the plan. The attempt to weave the fragments into a connected whole, and their division into the three Logoi, may be regarded on the whole as a decided failure.

Schuster finds only thirteen fragments for the concluding theological section, although our knowledge of Heraclitus and his times would rather indicate, as indeed Teichmüller thinks probable, that the theological section was the principal portion of the book.

Turning now to the theory of knowledge, according to Schuster, as we have seen, Heraclitus is an empiricist and sensationalist and knows no world but the visible. With this conclusion we cannot agree. Schuster's argument that this doctrine must have arisen with Heraclitus since it was held by Protagoras, his disciple, has little weight. The order of development was rather that pointed out by Plato himself in the Theaetetus (p. 151 ff.), namely, that the sensational theory of knowledge was the outcome of the Protagorean doctrine that man is the measure of all things, and that this in turn grew out of the Heraclitic flux. No doubt the sensational theory was implied by the Sophists, but it was incipient with them and not yet formulated. Much less can it be attributed to Heraclitus, whose contribution to the theory began and ended with the eternal flux. A sensational theory of knowledge, it is quite true, was likely to be an outcome of the Ephesian's philosophy, but he did not himself proceed thus far. The question, theoretically considered, was beyond his time. There are passages which indicate that he held, inconsistently it may be, quite the opposite doctrine. "Eyes and ears," he says, "are bad witnesses to men having rude souls" (Sextus Emp. adv. Math. vii. 126; = frag. 4; cp. frags. 3, 5, 6, 19, etc., and below (p. 609). The passage which offers Schuster the strongest support for his sensationalism is that noted above (p. 572) from Hippolytus, "Whatever concerns seeing, hearing and learning (μάθησις, Schuster

translates "Erforschung"), I particularly honor" (frag. 13). Adopting the simplest and most natural meaning of this passage, it has no bearing on any theory of knowledge, but means merely, as Pfleiderer points out (Heraklit, p. 64, note), that Heraclitus prefers the pleasures of the higher senses, as of seeing, hearing, and the knowledge acquired thereby, to the sensual pleasures of the lower senses which the masses pursue. If, however, Schuster will take it in a theoretical sense, then it comes into conflict with the other passage, "The hidden harmony is better than the visible." The contradiction is foreseen by Schuster, who deliberately changes the latter into a question (see above, p. 572), without a shadow of right, as may be seen by reference to the context in Hippolytus (see below, frag. 47), who expressly states that the two passages seem to conflict. Further support for his interpretation Schuster seeks in the following passage from Hippolytus :

Τοῦ δὲ λόγου τοῦδ' ἐόντος αἰεὶ ἀξύνετοι γίνονται ἄνθρωποι καὶ πρόσθεν ἢ ἀκοῦσαι καὶ ἀκούσαντες τὸ πρῶτον. γινομένων γὰρ πάντων κατὰ τὸν λόγον τόνδε ἀπείροισι ἐοίκασι πειρώμενοι καὶ ἐπέων καὶ ἔργων τοιουτέων ὁκοίων ἐγὼ διηγεῦμαι, διαιρέων ἕκαστον κατὰ φύσιν καὶ φράζων ὅκως ἔχει (Ref. haer. ix. 9 ; = frag. 2).

This is the passage of which Schuster says that if Heraclitus had written nothing more it would have given him a place of honor in philosophy, for here for the first time appeared the thought that has inspired speculation and modern science since the Renaissance, that truth is to be sought in the observation of Nature. But we are unable to find here any such meaning. The sense of the passage depends upon the sense of Logos. Of course, if Schuster is free to translate this word in any way he chooses, he can get from the pas-

sage almost any meaning. He chooses to render it the Voice of Nature or the Speech of the visible world. In this he is not supported by any other critics. By ancient commentators of Heraclitus the Logos was understood as Reason, and in this general sense it is taken by modern commentators including Heinze, Zeller, Teichmüller, and Pfleiderer, although more specifically they see that, in harmony with the whole Heraclitic philosophy, it is to be taken as Reason immanent in the world as Order or Law. Schuster objects that Logos could not mean Reason, since before the time of Heraclitus it had never been so used, and no author would venture to introduce at the very beginning of his work words with new meanings. But precisely the same objection applies to its meaning the Speech of Nature, for the whole point in Schuster's exposition is that this was an original idea with Heraclitus. If the Logos is conceived as Order, this objection is met, since this meaning is given in the derivation of the word. Moreover, if Schuster could show that the word meant "speech" or "discourse," then the discourse referred to must have been not that of Nature but of the author himself. Finally, if we adopt Reason as the meaning of Logos here, the whole passage, so far from supporting, directly refutes Schuster's sensational theory of knowledge. Another argument for the empiricism of Heraclitus, Schuster seeks in his denunciation of the people for their failure to interest themselves in acquiring knowledge by empirical investigation of the things that surround them, which he bases on a couple of passages from Clement and M. Aurelius (see above, p. 571). Heraclitus, in fact, said nothing of the kind; but Schuster, by conjectural reconstruction of the text and an arbitrary

translation, extracts a theoretical meaning from simple sentences which no one who had not a preconceived theory to support would ever imagine to mean more than a reproach upon the masses for their superficiality and neglect of interest in a deeper knowledge of the world (see Schuster, p. 17, and cp. frags. 5, 93). What Heraclitus' theory of knowledge really was we shall see more fully in the examination of Pfleiderer's position later. Here it is sufficient to add that, whatever empirical tendency his philosophy may have had, any such positive doctrine as that which Schuster ascribes to him was far beyond the time of Heraclitus.

Schuster's interpretation of the Heraclitic *χρησμοσύνη* and *κόρος* is also open to criticism. Zeller, indeed, has given a similar explanation of these words (Vol. 1, p. 641), but Pfleiderer has understood them differently (p. 176). From Heraclitus himself there remains only the two above words (frag. 24). Hippolytus (Ref. haer. ix. 10, cp. frag. 24, sources) says that the arrangement of the world (*διακόσμησις*), Heraclitus called "craving" (*χρησμοσύνη*), and the conflagration of the world (*ἐκπύρωσις*) he called "satiety" (*κόρος*). Schuster, therefore, understanding by *διακόσμησις*, not the process of world-building, that is, the passing of the homogeneous original fire into the manifold of divided existence, but the completed manifold world itself or the *κόσμος*, interprets the "craving" or hunger as belonging to the present differentiated world, which hungers, as it were, to get back into the state of original fire or satiety. The testimony is too meagre to say that this is not a possible interpretation, but it seems to be wrong. For Schuster admits, as of course he must, that the original fire carries within itself an impulse to change and develop into a manifold world. But

this impulse to change is hardly consistent with a state of perfect "satiety." If now we take διακόσμησις in its primary signification denoting the action or process of arranging, then craving becomes the designation of the world-building process itself. Craving then is nothing but the original impulse to evolve itself, contained in the primitive fire, while the reverse process, the conflagration, is satiety, or better, the result of satiety.

Teichmüller.

The work of Teichmüller (see above, p. 560) does not profess to be a complete exposition of the philosophy of Heraclitus, but to indicate rather the direction in which the interpretation is to be found. Teichmüller believes that the philosophy of the ancients is to be interpreted by their theories of Nature. Physics came before metaphysics. Particularly does this apply to Heraclitus of Ephesus. His philosophy of Nature, therefore, is the key with which Teichmüller will unlock the secrets of his system (Teichmüller, I, p. 3).

But yet Heraclitus was not a naturalist. Of the sun, moon, eclipses, seasons, or earth, he has little to say. In the astronomy of Anaximander or the mathematics of Pythagoras he took little interest. On such polymathy he cast a slur (Diog. Laert. ix. 1; cp. frag. 16). He went back to Thales and started from his childlike conception of Nature. To Heraclitus the earth was flat, extending with its land and sea indefinitely in each direction. The sun, therefore, describes only a semicircle, kindled every morning from the sea and extinguished in it every evening. Moreover, the sun is no larger than it looks (Diog. Laert. ix. 7). The sun, therefore, cannot pass his boundaries (of the half-circle), else the Erinyes (who inhabit the lower world)

will find him out (Plutarch, de Exil. ii. p. 604; = frag. 29). Up and down are not relative but absolute directions (Teichmüller, I, p. 14).

Thus upon physical grounds we may interpret at once some of the aphorisms. For instance, since the sun is a daily exhalation from the earth, sun and earth must have in part a common substance; hence Dionysus and Hades are the same (Clement of Alex. Protrept. ii. p. 30; cp. frag. 127), since the former stands for the sun and the latter for the lower world. Likewise day and night are the same (Hippolytus, Ref. haer. ix. 10; cp. frag. 35), since they are essentially of the same elements, the difference being only one of degree, the former having a preponderance of the light and dry, the latter of the dark and moist (Teichmüller, I, pp. 26, 56).

The four elements, fire, air, earth, and water, are not, as with Empedocles, unchangeable elements, but in ceaseless qualitative change are continually passing into one another. Experience itself teaches this in the daily observation of such phenomena as the drying up of swamps, the melting of solids, and the evaporation of liquids (Id. I, p. 58).

Fire is not a symbol, but is real fire that burns and crackles. It is the ground principle, the entelechy of the world, in which reside life, soul, reason. It is God himself. It is absolute purity. It rules in the pure upper air, the realm of the sun. Its antithesis is moisture, absolute impurity, which rules in the lower regions of the earth. The sun with his clear light moves in the upper fiery air. The moon with her dimmed light moves in the lower moister air. The central thought, therefore, is purification, or "the way up," from the moist and earthy to the dry and fiery (Id. I, p. 62 ff.).

The psychology of Heraclitus is not analogous, but identical with his physics. The soul is the pure, light, fiery, incorporeal principle which burns like the sun. Its degree of life and intelligence depends upon its purity from moisture. The stupid drunken man has a moist soul (Stobaeus Floril. v. 120; cp. frag. 73). "The dry soul is the wisest and best" (frag. 74). In sleep the fire principle burns low; in death it is extinguished, when the soul, like the sun at night, sinks into the dark regions of Hades. Hence it follows that there was with Heraclitus no doctrine of the immortality of the soul (Teichmüller, I, p. 74 ff.).

Ethics, therefore, is purification, and in this thought we see the origin of that general idea which as "Catharsis" became prominent in Plato and later philosophy. Teichmüller finds it of the greatest interest to have traced the history of this idea, with its related one of "separation" or "apartness," back to Heraclitus. "Of all whose words I have heard," says the latter, "no one has attained to this—to know that Wisdom is apart (κεχωρισμένον) from all" (Stobaeus Floril. iii. 81; = frag. 18). This "separateness" of Wisdom, which was only another term for reason, God or pure fire, reveals the origin of the distinction of the immaterial from the material. With Heraclitus, to be sure, the idea of immateriality in its later sense was not present, but fire as the *most* incorporeal being of which he knew, identical with reason and intelligence, was set over against the crude material world. We have therefore here neither spiritualism nor crude materialism, but the beginning of the distinction between the two. With Anaxagoras another step was taken when fire was dropped and the Nous was conceived in pure separateness apart even from

fire. Following Anaxagoras, Plato regarded the Ideas as distinct and separate (εἰλικρινές, κεχωρισμένον). In Aristotle it appears as the separation (χωριστόν) which belongs to absolute spirit or pure form. Finally in the New Testament it is seen as the purity (εἰλικρίνεια) which is opposed to the flesh (Paul, Epist. to Corinth. II, i. 12; ii. 17). Human intelligence, according to Heraclitus, attains only in the case of a few to this greatest purity, this highest virtue, this most perfect knowledge. They are the chosen ones, the elect (ἐκλεκτοί) (Teichmüller, I, p. 112 ff.).

The senses, since they partake of the earthy character of the body, give us only deceitful testimony as compared with the pure light of Reason, which alone, since it is of the essence of all things, that is, fire, has the power to know all. Here therefore was the first distinction of the intelligible from the sensible world (Id. I, p. 97).

Again, in the qualitative change of Heraclitus we discover the incipient idea of the actual and potential first formulated by Aristotle. Since the elements pass into one another, they must be in some sense the same. Water is fire and fire is water. But since water is not actually fire, it must be so potentially. To express this idea, Heraclitus used such phrases as "self-concealment," "sunset," "death," "sleep," "seed" (Id. I, p. 92 ff.).

Moreover, inasmuch as we have a progress from the potential to the actual, from the moist and earthy to the dry and fiery, that is, from the *worse* to the *better*, we find in Heraclitus the recognition of an end or purpose in Nature, or a sort of teleology, subject, however, to the rule of rigid necessity (Id. I, p. 137).

The flux of all things Teichmüller understands not

as a metaphysical proposition, but as a physical truth gained by generalization from direct observation of Nature. Furthermore, it was nothing new, all the philosophers from Thales on having taught the motion of things between beginning and end (Id. I, p. 121).

That which *was* new in this part of Heraclitus' work was his opposition to the transcendentalism of Xenophanes. Over against the absolute, unmoved and undivided unity of the Eleatic philosopher, Heraclitus placed the unity of opposition. In Xenophanes' system, above all stood the immovable, transcendent God. In Heraclitus' system there was nothing transcendent or immovable, but all was pursuing the endless way upward and downward. His God was ceaselessly taking new forms. Gods become men, and men gods (Heraclitus, Alleg. Hom. 24, p. 51, Mehler; cp. frag. 67). The immanent replaces the transcendent. Here emerges the historically significant idea of unity. Against the unity of Xenophanes, a unity opposed to the manifold, Heraclitus grasped the idea of a unity which includes the manifold within itself. "Unite whole and part, agreement and disagreement, accordant and disaccordant—from all comes one, and from one all" (Arist. de mundo 5, p. 396, b. 12; = frag. 59). Everywhere is war, but from the war of opposites results the most beautiful harmony (cp. frag. 46). Here three principles are involved: 1). Through strife all things arise; the birth of water is the death of fire, the death of water is the birth of earth, etc. (cp. frag. 68). 2). Through strife of opposites all things are preserved; take away one, the other falls; sickness is conditioned by health, hunger by satiety (cp. frag. 104). 3). There is an alternating mastery of one or the other opposite; hence it follows that since all opposites proceed

from one another, they are the same (Teichmüller, I, p. 130 ff.).

What did Heraclitus mean by the visible and invisible harmony? Teichmüller censures Schuster for failing to recognize that most significant side of Heraclitus' philosophy which is represented by the invisible harmony—in other words, for reducing him to a mere sensationalist. The visible harmony, according to Teichmüller, is the entire sensible world, in which the war of opposites results in a harmony of the whole. But the invisible harmony is the divine, all-ruling and all-producing Wisdom or World-reason, concealed from the senses and the sense-loving masses and revealed only to pure intellect. Thus Heraclitus, to whom there was an intelligible world revealing itself to intellect alone, and in the recognition of which was the highest virtue, was the forerunner of Plato (Id. I, pp. 154, 161 ff.).

By the Logos of Heraclitus was indicated Law, Truth, Wisdom, Reason. It was more than blind law, thinks Teichmüller, it was self-conscious intelligence; for self-consciousness, according to Heraclitus, who praised the Delphic motto, "Know thyself," is the highest activity of man, and how could he attribute less to God, from whom man learns like a child? (cp. frag. 97). But this self-conscious reason is not to be understood as a constant, ever abiding condition. God, who in this purely pantheistic system is one with the world, is himself subject to the eternal law of ceaseless change, pursuing forever the downward and upward way. But is not then God, Logos, Reason, subject, after all, to some higher destiny (εἱμαρμένη)? No, says Teichmüller, for it is this very destiny which it is the highest wisdom in man to recognize, and

which is, therefore, identical with the Wisdom which rules all. The difficulty here he so far admits, however, as to acknowledge that this doctrine is "dark and undetermined" (Id. I, p. 183 ff.).

Finally, says our author, there was no idea of personality of spirit in the philosophy of Heraclitus, as there was not in any Greek philosopher from Xenophanes to Plotinus (Id. I, 187).

In closing this part of his exposition, Teichmüller calls attention to the relation of Heraclitus to Anaxagoras. M. Heinze (Lehre vom Logos, p. 33), following Aristotle, attributes to Anaxagoras the introduction into philosophy of the idea of world-ruling intelligence. But, says Teichmüller, this idea was present to every Greek from Homer on. Its recognition by Heraclitus has been shown by the fact that everywhere he attributes to his God, wisdom (*σοφία*), intelligent will (*γνώμη*), reason (*φρονοῦν* and *φρενήρες*), and recognized truth (*λόγος*). What then did Anaxagoras add? The history of the idea of transcendent reason turns upon two characteristics, Identity (*ταὐτότης*) and Pure Separation (*εἰλικρινές*). With Heraclitus both failed; the former, because the World Intelligence took part in the universal change; the latter, because it was mingled with matter. For, in choosing fire for his intelligent principle, although as Aristotle says he chose that which was least corporeal (*ἀσωματώτατον*), he did not escape a sort of materialism. The new that Anaxagoras added, therefore, was the complete separation of reason from materiality. In a word, while the Logos of the Ephesian was at once world-soul and matter in endless motion, the Nous of Anaxagoras was motionless, passionless, soulless and immaterial. Identity, the other attribute, was added in the epoch-

making work of Socrates when the content of reason was determined by the definition, following whom Plato established the complete transcendence of the ideal world (Teichmüller, I, 189 ff.).

Heraclitus assumed a world-year or world-period, the beginning of which was the flood, and whose end was to be a universal conflagration, the whole to be periodically repeated forever. In this he was preceded by Anaximander and followed by the Stoics. This general idea was adopted by the Christian Church, but the latter limited the number of worlds to three, the first ending with the flood; ours, the second, to end with the conflagration of the world; the third to be eternal (Epist. Pet. II, iii. 4 ff.; Clement of Rome, Epist. to Corinth. i. 57, 58); (Teichmüller, I, 198 ff.).

In the second part of his work, Teichmüller enters upon an exhaustive argument to show the dependence of the Heraclitic philosophy upon Egyptian theology. Heraclitus moved within the sphere of religious thought. He praised the Sibyl and defended revelation and inspiration (Plutarch, de Pyth. orac. 6, p. 397; cp. frag. 12). His obscure and oracular style, like that of the king at Delphi (cp. frag. 11), was in conformity with his religious character. Observation of Nature he fully neglected, depending for his sources more than any other philosopher upon the beliefs of the older theology. Without deciding how far Heraclitus is directly, as a student of the Book of Death, or indirectly by connection with the Greek Mysteries, dependent upon the religion of Egypt, he proceeds to indicate the interesting points of similarity between them (Teichmüller, II, p. 122).

Among the Egyptians the earth was flat and infinitely extended. The visible world arose out of water.

The upper world belonged to fire and the sun. As the sun of Heraclitus was daily generated from water, so Horus, as Ra of the sun, daily proceeded from Lotus the water. As the elements with Heraclitus proceed upward and downward, so the gods of the elements upon the steps in Hermopolis climb up and down (Id. II, p. 143).

With these illustrations, it is sufficient to say, without following him further in detail, that Teichmüller carries the comparison through the whole system of Heraclitus, and parallels his actual and potential, his unity of opposites, his eternal flux, strife, harmony, purification, Logos, and periodicity of the world, with similar notions found in the religion of Egypt.

In order to appreciate the worth of Teichmüller's work, it is necessary to remember that, as we have said, it does not profess to be a unified exposition of Heraclitus' philosophy, but a contribution to the history of philosophic ideas in their relation to him. In affording this service to the history of ideas, he has thrown a good deal of light upon the true interpretation of the philosophy of Heraclitus. But the very purpose of his task has caused him to put certain of the ideas into such prominence, that unless we are on our guard, we shall not get therefrom a well proportioned conception of the system as a whole. We shall do well, consequently, to make a short examination of the work outlined in the foregoing pages, to put the results, if we can, into their fit relation to the whole.

Concerning Teichmüller's starting point, namely, that the physics of Heraclitus is the key to his whole thought, we must observe, in passing, the inconsistency between the first part of Teichmüller's book,

where this principle is made the basis of interpretation, and the second part, where it sinks into comparative insignificance when he discovers that Heraclitus is primarily a theologian and gets his ideas from Egyptian religion. To say that we shall better appreciate a philosopher's position if we understand his astronomy and his theories of the earth and nature, is of course true to every one. Moreover, that Heraclitus considered the earth as flat, the sun as moving in a semicircle and as no larger than it looks, the upper air as drier than the lower, and the lower world as dark and wet, there is no reason to deny. In fact, this cosmology, as Teichmüller details it, is so simple and blends so well with the Heraclitic sayings in general, that the picture of it once formed can hardly be banished from the mind. But that it adds much to the explication of the philosophy as a whole is doubtful. It is true that physics came before metaphysics, if by that is meant that men speculated about Nature before they speculated about being. But this distinction has little bearing on the interpretation of Heraclitus. A principle more to the point, and one that Teichmüller has not always observed, is that religion, poetry and metaphor came before either physics or metaphysics. From the very fact, also, that physics came before metaphysics, when the latter did come, men were compelled to express its truths in such physical terms as they were in possession of. He therefore who will see in the sentences of Heraclitus nothing beyond their physical and literal meaning, will miss the best part of his philosophy. For instance, Teichmüller interprets the saying that day and night are the same, as meaning that they are made up of the same physical constituents (see above, p. 583). If possible, this is worse than

Schuster's explanation that they are the same because they are each similar divisions of time (!), an explanation which Teichmüller very well ridicules (Id. I, p. 49). No such childish interpretations of this passage are necessary when it is seen that this is simply another antithesis to express Heraclitus' great thought of the unity of opposites, on the ground that by the universal law of change, opposites are forever passing into each other, as indeed is said in so many words in a passage from Plutarch which these critics seem to have slighted (Consol. ad Apoll. 10, p. 106; see frag. 78). Equally unnecessary and arbitrary is Teichmüller's singular attempt to prove on physical grounds the identity of the two gods, Dionysus and Hades (see above, p. 583).

In pursuance of his method, Teichmüller supposes that the Heraclitic fire was real fire such as our senses perceive, fire that burns and crackles and feels warm. No other critic agrees with him in this. Zeller especially opposes this conception (Vol. I, p. 588). It is not to be supposed that Teichmüller understands Heraclitus to mean that the present world and all its phenomena are real fire. Fire he conceives to be, rather, the first principle or ἀρχή, the real essence of the universe, chosen as water was by Thales or air by Anaximenes, only with more deliberation, since fire has the peculiarity of taking to itself nourishment. In a word, since anybody can see that our present earth, water, and air, are not fire that burns and crackles, all that Teichmüller can mean is that this kind of fire was the original thing out of which the present world was made. But there is not the least support for this meaning in any saying of Heraclitus. In all the sentences, fire is conceived as something of the present,

something directly involved in the ceaseless change of the world. "Fire, (*i. e.*, κεραυνός, the thunderbolt)," he says, "rules all" (Hippolytus, Ref. haer. ix. 10; =frag. 28). "This world, the same for all, neither any of the gods nor any man has made, but it always was, *and is*, and shall be, an ever living fire" (Clement of Alex. Strom. v. 14, p. 711; =frag. 20). "Fire is exchanged for all things and all things for fire" (Plutarch, de EI. 8, p. 388; =frag. 22). These passages are sufficient to show that Teichmüller's conception of the fire is untenable. We may, however, mention the fact noted by Zeller (Vol. I, p. 588), that both Aristotle (de An. i. 2, 405, a, 25) and Simplicius (Phys. 8, ~a) explain that Heraclitus chose to call the world fire "in order to express the absolute life of Nature, and to make the restless change of phenomena comprehensible."

Another point that demands criticism is the idea of actuality and potentiality which Teichmüller finds hidden in Heraclitus' philosophy and metaphorically expressed by sunset, death, sleep, etc. Since there is a qualitative interchange of the elements, they must be in some sense the same. Water is fire and fire is water. But since water is not actually fire, it must be so potentially. Therefore, water is potential fire. Such is Teichmüller's reasoning, as we have seen. Of course, it can be reversed with equal right. Since fire is not actually water, it must be so potentially. Therefore, fire is potential water. Which is to say that we have here a simple reversible series in which there is not only an eternal progress (or regress) from fire to water, but equally, and under the same conditions, an eternal regress (or progress) from water to fire. Either, therefore, may, with as good right as the other,

represent actuality or potentiality. In other words, actuality and potentiality are superfluous ideas in this system. In fact, this antithesis has no place in metaphysics outside the philosophy of Aristotle, and he who has failed to see that right in this connection lies the main difference between the philosophy of Aristotle and that of Heraclitus, has missed the most vital part of the latter. With Aristotle there is an eternal progress but no regress. The potential is ever passing into the actual, but not the reverse. To be sure, a thing may be both actual and potential, but not as regards the same thing. The hewn marble is potential as regards the statue and actual as regards the rough marble, but of course the hewn marble and the statue cannot be reciprocally potential or actual. Matter is eternally becoming form, but not the reverse. Thus follows Aristotle's necessary assumption of a prime mover, an inexhaustible source of motion, itself unmoved—pure actuality, without potentiality. Hence the mainspring of the peripatetic philosophy is the *unmoved moving first cause.* But the philosophy of the Ephesian is the reverse of all this. With him there is no fixed being whatever (see Teichmüller himself, I, p. 121: "Es bleibt dabei nichts Festes zurück," etc.), no unmoved first cause outside the shifting world which is its own God and prime mover. Thus Teichmüller, in identifying the Heraclitic fire with the Aristotelian pure actuality, overlooked the slight difference that while the one is absolute motion, the other is absolute rest! We are glad, however, not to find this Aristotelian notion, which, though prevalent in metaphysics, has never added a ray of light to the subject, present in the philosophy of the Ephesian, and we see here another case of over-interpretation by which

Heraclitus' innocent use of such terms as sunset, death, and self-concealment, caused Aristotelian metaphysics to be forced upon him.

In tracing the history of ideas, much emphasis has been laid by Teichmüller, as we have seen, upon the idea of purification (*κάθαρσις*) as it appears in Heraclitus, and in connection therewith he has found the beginning of the idea of the "apartness" or "separation" of the immaterial world, an idea so enormously enlarged by Anaxagoras and Plato. As regards the Catharsis proper, Teichmüller has rendered a service by pointing out Heraclitus' connection with the idea; but in reading Teichmüller's book, one would be easily led to believe that the Catharsis idea is much more prominent in Heraclitus than it really is, and as regards the doctrine of "separation," it seems at once so incongruous with the system as a whole that we must inquire what foundation, if any, there is for it. The student of Heraclitus knows, although the reader of Teichmüller might not suspect, that the words *κάθαρσις*, *καθαρός*, *εἰλικρινές*, *εἰλικρίνεια*, *χωριστόν*, *χωρισθέν*, *ἐκλεκτοί*, themselves do not occur in the authentic remains of his writings. One exception is to be noted. The word *κεχωρισμένον* occurs in the passage from Stobaeus already noticed (see above, p. 584). It is as follows: *Ὁκόσων λόγους ἤκουσα οὐδεὶς ἀφικνέεται ἐς τοῦτο, ὥστε γινώσκειν ὅτι σοφόν ἐστι πάντων κεχωρισμένον* (Stobaeus Floril. iii. 81). This passage Teichmüller uses as his text in establishing the connection of Heraclitus with the doctrine of "separation," unfortunately, however, first because he has not found the correct interpretation of it, and second, because, if he had, it would stand in direct contradiction to the doctrine of immanence which he spends all the next chapter in estab-

lishing for Heraclitus. *Σοφὸν* in this passage does not stand for the world-ruling Wisdom or Reason, or Divine Law, of which Heraclitus has so much to say in other passages. To assert the "apartness" of that Law would be to disintegrate the entire system, the chief point of which is the immanence of the Divine Law as the element of *order* in the shifting world. It does not follow that because *τὸ σοφόν* is used in the above larger sense in the passage from Clement of Alexandria (Strom. v. 14, p. 718; = frag. 65), that *σοφόν* cannot be used in quite the ordinary sense in the present passage. That it is so is attested by the agreement of Schuster (p. 42), Heinze (Lehre vom Logos, p. 32), Zeller (Vol. I, p. 572, 1), and Pfleiderer (p. 60). Lassalle, indeed, agrees with Teichmüller. Schuster, following Heinze, understands the sentence to mean merely that wisdom is separated from all (men), that is, true wisdom is possessed by no one. Zeller, followed by Pfleiderer, renders it: "No one attains to this—to understand that wisdom is separated from all things, that is, has to go its own way independent of general opinion." Schuster's interpretation is the most natural, so that the fragment belongs among the many denunciations of the ignorance of the common people—as indeed Bywater places it—and has nothing to do with any theory of the "separateness" of an absolute or immaterial principle. Neither is there any other passage which supports this doctrine. In further support, however, of the Catharsis theory in general, Teichmüller alleges the passage from Plutarch (Vit. Rom. 28), which speaks of the future purification of the soul from all bodily and earthy elements, and which Teichmüller thinks to have a strong Heraclitic coloring. In this passage Heraclitus is quoted as

saying that "the dry soul is the best," but beyond this fragment it is a mere conjecture that it was taken from him. The passage at any rate is unimportant. What then remains to establish any connection whatever of Heraclitus with the "history of the idea of the εἰλικρινές"? Only the most general antithesis of fire and moisture, with the added notion that the former is the better and the latter worse. Since the divine essence of the universe itself is fire, the way upward from earth and water to fire is the diviner process, and pure fire is the noblest and highest existence. But this is shown better in the ethical sphere. The soul itself is the fiery principle (Arist. de An. i. 2, p. 405, a, 25). "The dry soul is the wisest and best" (frag. 74). The soul of the drunken, stupid man is moist (cp. frag. 73). The highest good was to Heraclitus the clearest perception, and the clearest and most perfect perception was the perception of the Universal Law of Nature, the expression of which was pure fire; and such perception was coincident with that condition of the soul when it was most like the essence of the universe. This is the sum-total of the idea of the Catharsis found in Heraclitus. It is worthy of notice, to be sure, but it is not so different from what might be found in any philosophy, especially an ethical philosophy, as to make it of any great moment, either in the history of ideas or in the exposition of this system.

We have studied now those parts of Teichmüller's work which, either by reason of their incompleteness or manifest error, most needed examination, namely his method, his wrong conception of the Heraclitic fire, his useless and unfounded theory of the actual and potential and of the separateness of the immaterial, and his over-emphasized doctrine of the Cathar-

sis. Concerning the other points, it is only necessary in addition to call attention to the extreme value of his contribution in his explanations of the relation of Heraclitus to Xenophanes, to Anaxagoras and to Plato, of the Heraclitic Logos, of the flux, of the unity of opposites, and of the invisible harmony and the intelligible world defended against the sensationalism of Schuster. In the second part of his work also, though its value is less, he has contributed not a little light by his emphasis of the theological character of this philosophy, though one doubts whether his laborious collection of resemblances between the philosophy of the Ephesian and the religion of Egypt has shed much light on Heraclitus' position. It is seen at once that by taking such general conceptions as war and harmony, purification, periodicity of the world, etc., it would be easy to make a long list of parallelisms between any religion and any system of philosophy not separated farther in time and place than Heraclitus of Ephesus and the Egyptians. The resemblances, however, are certainly not all accidental, but they are such as do not affect the originality of the Ephesian, and unfortunately do not add much to a better knowledge of his philosophy.

Pfleiderer.

Dr. Edmund Pfleiderer comes forward in a recent volume of 380 pages (see above, p. 560), with an attempt to interpret the philosophy of Heraclitus from a new and independent standpoint. He expresses dissatisfaction with all previous results. Other critics have made the mistake of starting not from the positive but from the negative side, namely, from the universal flux (as Zeller), or from the law of opposites (as Lassalle). But the hatred of the opinions of the masses which

Heraclitus exhibits, calls for some greater philosophical departure than the above negative principles, which indeed were already well known truths. Moreover, if we take these for his starting point, we can get no consistent system, for the doctrine of the universal flux does not lead naturally to the law of opposites, but rather the reverse. Again, neither the flux nor the law of opposites harmonizes with the doctrine of fire. Finally, the pessimistic, nihilistic tendency of the theory of absolute change does not agree well with the deep rationality and world-order which Heraclitus recognizes in all things, nor with his psychology, eschatology, and ethics (Pfleiderer, p. 7 ff.).

We must look elsewhere for his ground principle. To find it, we must discover the genesis of this philosophy, which did not spring into being spontaneously, like Pallas Athena from the head of her father. It could not have come from the Eleatics, for the chronology forbids, nor from Pythagoras, whom Heraclitus reviles, nor finally from the physicists of Miletus, with whose astronomy Teichmüller has well shown our philosopher to be unacquainted. Its source is rather to be sought in the field of religion, and particularly in the Greek Mysteries. In the light of the Orphico-Dionysiac Mysteries, in a word, according to Pfleiderer, this philosophy is to be interpreted. Here is the long-sought key. The *mystic* holds it, as indeed Diogenes Laertius says :

> *Μὴ ταχὺς Ἡρακλείτου ἐπ' ὀμφαλὸν εἴλεε βίβλον*
> *τοὐφεσίου· μάλα τοι δύσβατος ἀτραπιτός.*
> *ὀρφνὴ καὶ σκότος ἐστὶν ἀλάμπετον· ἢν δέ σε μύστης*
> *εἰσαγάγῃ, φανεροῦ λαμπρότερ' ἠελίου.*—ix. 16.

With the religion of the Mysteries, in its older and purer form, Heraclitus was in full sympathy. By his

family he was brought into close connection with it. Ephesus, too, his city, was a religious centre. Diogenes (ix. 6) relates that he deposited his book in the temple of Artemis. Heraclitus, indeed, was not a friend of the popular religion, but that was because of its abuses, and it was in particular the popular Olympian religion that he attacked. The connection of the Ephesian with the Mysteries may be considered as a deep-seated influence which their underlying principles exerted upon him. These religious principles he turned into metaphysics. His system as a whole was religious and metaphysical (Pfleiderer, p. 32 f.).

With this introduction, Pfleiderer proceeds as follows. Heraclitus' starting point lay positively in his *theory of knowledge*, which was a doctrine of speculative intuition and self-absorption. In this sense our author understands the fragment from Plutarch (adv. Colot. 20, p. 1118; = frag. 80), *'Εδιζησάμην ἐμεωυτόν*, "I searched within myself," that is, I wrapped myself in thought, and so in this self-absorption I sought the kernel of all truth. Hence his contempt for the masses who act and speak without insight. But does not this conflict with those Heraclitic sentences which place the standard of truth and action in the common or universal (*ξυνόν*)? (cp. frags. 92, 91). Do these not lead as Schuster holds, to the rule, *Verum est, quod semper, quod ubique, quod ab omnibus creditum est?* No, says Pfleiderer, the common here does not mean the general opinion of the majority. All such interpretations are sufficiently refuted by that other passage, "To me, one is ten thousand if he be the best" (frag. 113). What Heraclitus really meant by the common (*ξυνόν*) was "the true inward universality." Absorption into one's inner self was absorption into that

ground of reason which is identical with the divine principle of the world. By this universal reason under which he contemplated all things, Heraclitus meant nothing different from what by Spinoza was expressed by "sub specie aeternitatis," and in subsequent philosophy by "intellectual intuition" and "the standpoint of universal knowledge." Heraclitus fell back upon that universal instinct which in the form of human language is exhibited as the deposit of successive ages, and which again he did not distinguish from the voice of the Sibyl, representative of divine revelation. As respects the source of knowledge, Heraclitus as little as Spinoza, Fichte and Hegel, looked to himself as individual, but rather to that singular and qualitative divine source in which the individual participates (Pfleiderer, p. 46 ff.).

The senses, though they do not give us the whole truth, yet furnish the sufficient data that are to be interpreted by the light of reason. The errors of the masses do not arise from trusting the senses, for the latter give not a false, but a partial account. Their error lies in missing the spiritual band which unites the manifold of sense into the higher unity, an error distinctive of the popular polytheism as against the religion of the Mysteries (Id. p. 70).

The theory of knowledge, Heraclitus' starting point, being thus disposed of, Pfleiderer proceeds to discuss the material principles of his philosophy in their abstract metaphysical form. The keynote here is the *indestructibility of life.* The oscillating identity of life and death, a truth adopted from the Mysteries, is taken up by Heraclitus and elevated into a universal and metaphysical principle. It is based on the simple observation of Nature, which sees the life and light

and warmth of summer passing into the death and darkness and cold of winter, only to be revived and restored in the never-failing spring. So on a smaller scale, day passes into night, but night ever again into day. So everywhere in Nature nothing passes away but to revive again. From this follows the hope of the universality of this law, the indestructibility of human life, and the resolution of the opposition between the light, warm life here above and the dark, cold death below. This is the hopeful element which characterizes the philosophy of the Ephesian. Over against it was the hopeless creed of the masses, whose complaint over the inexorable destiny of death found expression from the earliest times in the despairing lines of the poets. The common view does not see too much continuance and constancy in reality, but too little. "What we see waking," says Heraclitus, "is death, what we see sleeping is a dream" (Clement of Alex. iii. 3, p. 520; = frag. 64). Which means, that like the unreality and inconstancy of dreams is this ephemeral and perishing existence which we, the vulgar people, see when awake. Reversing this gloomy view, the Mysteries taught that Hades and Dionysus were the same (cp. frag. 127). That is, the god of death feared in the world below, is identical with the god of life and joy of the world here above, which is to say that the regenerative power of life persists even in death and shall overcome it (Pfleiderer, p. 74 ff.).

From this theory of the indestructibility of the fire force of life, Heraclitus passes to the ancillary truth of the unity of opposition in general. Hence he asserted the identity of day and night, winter and summer, young and old, sleeping and waking, hunger and satiety (cp. frags. 36, 78). His whole theory of the

harmony of opposites was, as it were, apologetic. If life rules in death, why does death exist? It was in answer to this question that Heraclitus developed his science of opposition and strife, by showing the presence here of a general law (Pfleiderer, p. 84 ff.).

In the same spirit Pfleiderer interprets the much contested figure of the harmony of the world as the harmony of the bow and the lyre (see frags. 45, 56). Without rejecting the interpretation suggested by Bernays (Rhein. Mus. vii. p. 94) and followed by most other critics, which refers the figure to the *form* of the bow and of the lyre, their opposite stretching arms producing harmony by tension, Pfleiderer finds in the comparison still another meaning. The bow and the lyre are both attributes of Apollo, the slayer and the giver of life and joy. Thus the harmony *between* the bow and the lyre, as attributes of one god—symbols respectively of death and of life and joy—expresses the great thought of the harmony and reciprocal interchange of death and life (Pfleiderer, p. 89 ff.).

The Heraclitic flux of all things, says Pfleiderer, was not antecedent to his abstract teachings, but the logical consequence thereof. The identity of life and death led him to the identity of all opposites. But opposites are endlessly flowing or passing into each other. Hence from the principle that everything is opposition, follows the principle that everything flows. The universal flux is only a *picture* to make his religious metaphysical sentences intelligible (Id. p. 100 ff.).

The Heraclitic fire is real fire as opposed to the logical symbol of Lassalle, but not the strictly sensible fire that burns and crackles, as Teichmüller supposes. It is rather a less definite conception, which is taken now as fire, now as warmth, warm air or vapor. It is

the concrete form or intuitional correlate of the metaphysical notion of life (Id. p. 120 ff.).

"The way up and down" refers not only to the transmutations of fire, water, and earth, but holds good in general for the oscillation of opposites, and particularly for the polarity of life and death (Id. p. 140).

As one result of his investigation, Pfleiderer affirms a strong optimistic element in the philosophy of the Ephesian. He contests the opinion of Schuster and Zeller that the endless destruction of single existences is kindred to the pessimistic doctrine of Anaximander, of the extinction of all individuals as an atonement for the "injustice" of individual existence. The process indeed goes on, but it has a bright side, and it is this that Heraclitus sees. Life, to be sure, is ever passing into death, but out of death life ever emerges. It is this thought, the powerlessness of death over the indestructible fire force of life, which Heraclitus emphasizes (Id. p. 180 ff.).

Still more decided is his rational optimism, his unswerving belief in a world well ordered and disposed. A deep rationality characterizes the universe (cp. frags. 2, 1, 91, 92, 98, 99, 96, 19). To express this idea, Heraclitus used the word Logos, which after his time played so prominent a part in the older philosophy. This word, passing even beyond its signification of "well ordered relation," conveyed finally with Heraclitus, as *λόγος ξυνός*, rather the idea of Reason immanent in the world (Pfleiderer, p. 231 ff.).

In the invisible harmony we find the same general thought. As distinguished from the visible harmony, which meant that external order of Nature insuring to the trustful peasant the never failing return of summer and winter, heat and frost, day and night,—the invisi-

ble harmony was that all-embracing harmony which is revealed to thought as the rational union of all oppositions. Against this theodicy there is no valid objection to be derived from the accounts which represent the Ephesian philosopher as sad and complaining, nor from the passages descriptive of the evils of life and the weakness of men (cp. frags. 86, 55, 112, etc.). In all cases these refer not to the philosopher's own opinions, but to the errors of the ignorant masses (Pfleiderer, p. 235 ff.).

The future existence of the soul, though not consistent with his physics and metaphysics, was nevertheless held from the religious and ethical standpoint. In fact it was involved, as has been shown, in Heraclitus' point of departure, so that we have less reason to complain of inconsistency in his case than we have, in reference to the same matter, in the case of the Stoics later (Id. p. 210).

We have given, perhaps, more space to the exposition of Pfleiderer's work than it relatively deserves, because it is the last word that has been spoken on Heraclitus, because, also, it has deservedly brought into prominence the optimism and the religious character of his philosophy, and because finally it presents another instructive example of over-systemization. It claims our attention, too, because the view it proposes is a complete reversal of the prevalent conception of Heraclitus, and if seriously taken, changes the whole tenor of his philosophy.

In what follows we shall examine chiefly the two main points in Pfleiderer's work, namely, the theory of knowledge and the connection with the Greek Mysteries; the latter, because it is Pfleiderer's particu-

lar contribution, and the former, because it will open to us an important aspect of the Ephesian's philosophy.

In the first place, however, it can by no means be admitted that the doctrine of the flux and the harmony of opposites represent the negative side of his system, and are secondary to his theory of knowledge and his religious dogmas. The unanimous testimony of the ancients cannot be thus easily set aside. That of Plato and Aristotle alone is decisive. Pfleiderer objects that Plato's purpose, which was to establish the changelessness of noumena against the change of phenomena, led him to emphasize the flux of Heraclitus. But if Heraclitus' positive teachings were, as Pfleiderer says, first of all the theory of knowledge, this and not the flux must have been emphasized in the Theaetetus where the theory of knowledge was Plato's theme. It is sufficient, however, here to note that what Heraclitus has stood for in philosophy from his own time to the present, is the doctrine of absolute change, and this doctrine may, therefore, properly be called the positive side of his philosophy. If what Pfleiderer means is that the theory of knowledge and not the flux was his starting point, he would have a shadow more of right. It is, however, misleading to say that his theory of knowledge was his starting point, for, as we have indicated in our examination of Schuster's work, Heraclitus was not concerned with a theory of knowledge as such. To state in a word what his point of departure really was, regarded from a common-sense view, it was his conviction that he was in possession of new truth which the blindness and ignorance of men prevented them from seeing (the point of departure indeed of almost every one who writes a book), and the three leading ideas in this

new truth were: 1. the absence of that stability in Nature which the untrained senses perceive; 2. the unsuspected presence of a universal law of order; 3. the law of strife which brings unity out of diversity. In one sense this may be called a theory of knowledge, and only in this sense was it his starting point.

But concerning the theory of knowledge itself, we cannot accept Pfleiderer's position. By placing it in speculative intuition and self-absorption, he has rushed to the very opposite extreme of Schuster's sensationalism, and in so doing has equally misrepresented Heraclitus. Either extreme is forcing a modern theory of knowledge upon the Ephesian of which he was wholly innocent. What support has Pfleiderer for his "self-absorption" theory? None whatever. He alleges the fragment *Ἐδιζησάμην ἐμεωυτόν* (cp. frag. 80), which he arbitrarily renders, "I searched within myself" ("Ich forschte in mir selbst"). This fragment is from Plutarch (adv. Colot. 20, p. 1118), Diogenes Laertius (ix. 5; cp. frag. 80, sources), and others. Plutarch understands it to refer simply to self-knowledge like the *Γνῶθι σαυτόν* at Delphi (similarly Julian, Or. vi. p. 185 A). Diogenes understands it as referring to self-instruction (similarly Tatian, Or. ad Graec. 3). Diogenes says, "He (Heraclitus) was a pupil of no one, but he said that he inquired for himself and learned all things by himself" (*ἤκουσέ τ' οὐδενός, ἀλλ' αὑτὸν ἔφη διζήσασθαι καὶ μαθεῖν πάντα παρ' ἑωυτοῦ*). The latter seems to be its true meaning, as is seen by comparing the passage from Polybius (xii. 27; cp. frag. 15), "The eyes are better witnesses than the ears." As here he means to say that men should see for themselves and not trust to the reports of others, so in the fragment in question he means only that he himself has inquired of

himself and not of others (cp. also frags. 14, 13). But Pfleiderer, in order to support a theory, has taken these two innocent words and pressed them into a doctrine of contemplative intuition, by giving them the meaning, "I wrapped myself in thought" ("Ich versenkte mich sinnend und forschend," etc., p. 47). So far is it from the case that Heraclitus sought the source of knowledge by turning inward, that he expressed himself directly to the contrary. Thus we read in Plutarch (de Superst. 3, p. 166; = frag. 95): *ὁ Ἡράκλειτός φησι, τοῖς ἐγρηγορόσιν ἕνα καὶ κοινὸν κόσμον εἶναι, τῶν δὲ κοιμωμένων ἕκαστον εἰς ἴδιον ἀποστρέφεσθαι*, the sense of which is well given by Campbell (Theaetetus of Plato, p. 246), "To live in the light of the universal Order is to be awake, to turn aside into our own microcosm is to go to sleep." Again, the whole passage from Sextus Empiricus (adv. Math. vii. 132, 133; cp. frags. 92, 2) is conclusive. "For," says Sextus, "having thus statedly shown that we do and think everything by participation in the divine reason, he [Heraclitus] adds, 'It is necessary therefore to follow the common, for although the Law of Reason is common, the majority of people live as though they had an understanding of their own.' But this is nothing else than an explanation of the mode of the universal disposition of things. As far therefore as we participate in the memory of this, we are true, *but as far as we separate ourselves individually we are false.* A more express denial of any self-absorption or *a priori* theory of knowledge would be impossible. Heraclitus is constantly urging men to come out of themselves and place themselves in an attitude of *receptivity* to that which surrounds them, and not go about as if self-included (cp. frags. 94, 3, 2). But what does Hera-

clitus mean by participation in the divine or universal Reason? Is not this just Pfleiderer's position when he says that the Ephesian as little as Fichte or Hegel looked to himself as individual, but rather to that absolute reason in which the individual participates? The difference is radical and vital, but Pfleiderer, like Lassalle, failed to see it because he did not free himself from strictly modern theories of knowledge. The difference is simply this. The universal reason of which Pfleiderer is speaking is that in which man *necessarily and by his intellectual nature* participates. That of Heraclitus is the divine Reason, in which man *ought* to participate but may not. Pfleiderer's universal reason is universal *in* man. That of Heraclitus, outside of and independent of man. The latter, so far from being necessarily involved in thought, is independent of thought. It is that pure, fiery and godlike essence, the apprehension of which gives rationality in the measure in which it is possessed. No reader, therefore, who can think of only two theories of knowledge, a strictly *a priori* theory and a strictly empirical theory, can understand Heraclitus. But, it may be asked, if knowledge does not come from without through the senses, nor from within from the nature of thought, whence does it come? Heraclitus, however, would not be disturbed by such a modern dilemma. There is reason, in fact, to believe, though it sounds strange to us, that he supposed this divine rational essence to be inhaled in the air we breathe (cp. Sextus Emp. adv. Math. vii. 127, 132). It exists in that which surrounds us (περιέχον), and the measure of our rationality depends on the degree in which we can possess ourselves of this divine flame. There was no conciseness of thought here, however, and Heracli-

tus seemed to think that it was partly apprehended through the senses, that is, the most perfect condition of receptivity to truth was the condition in which a man was most *awake.* The stupidest man is he who is asleep, blind, self-involved, and we may add, self-absorbed (cp. frags. 95, 90, 77, 3, 2, 94). Hence, if we have rightly interpreted Heraclitus here, a man might wrap himself in thought forever and be no nearer to truth. The source of knowledge did not lie in that direction to any pre-Socratic Greek philosopher. Absorption into one's inner self, which Pfleiderer thinks was Heraclitus' source of absolute knowledge, was the one thing he most despised.

Let us now consider the connection of Heraclitus with the Greek Mysteries, which Pfleiderer makes the basis of his interpretation of the whole philosophy. Pfleiderer has done a good work in emphasizing the religious character of the philosophy of the Ephesian. Lassalle and Teichmüller had already pointed it out. Failure to recognize this is the gravest fault in the critical work of Zeller. But as in Lassalle we found over-systemization of the logical idea, in Schuster of the empirical, in Teichmüller of the physical, so in Pfleiderer there is great over-systemization of the religious element. More strictly, it is a vast over-emphasis of one thought, namely, the indestructibility of life, or the alternating identity of life and death, which Pfleiderer claims to be a religious truth taken from the Mysteries, and out of which, as we have seen, he spins the whole philosophy of Heraclitus, including the doctrine of the eternal flux, the unity of opposites, and the fire. The slight grounds on which all this is based must have already impressed the reader with surprise that Pfleiderer should make so much out

of it. The fact that Heraclitus lived in Ephesus and that Ephesus was a very religious city, is a fair specimen of the arguments by which he would establish a connection with the Mysteries. There have been preserved only three fragments in which Heraclitus makes any direct reference to the Greek Mysteries, all taken from Clement of Alexandria (Protrept. 2, pp. 19, 30; cp. frags. 124, 125, 127), and in these three passages other critics have found no sympathy with, but stern condemnation of the mystic cult. In the first passage where the *νυκτιπόλοι, μάγοι, βάκχοι, λῆναι* and *μύσται* are threatened with future fire, Pfleiderer admits condemnation of mystic abuses. But the third fragment, relating to the Dionysiac orgies, is the one upon which he most relies to establish the sympathy of our philosopher with the Mysteries. The passage is as follows: *Εἰ μὴ γὰρ Διονύσῳ πομπὴν ἐποιεῦντο καὶ ὕμνεον ᾆσμα αἰδοίοισι, ἀναιδέστατα εἴργαστ' ἄν· ὡυτὸς δὲ' Ἀΐδης καὶ Διόνυσος, ὅτεῳ μαίνονται καὶ ληναΐζουσι.* "For were it not Dionysus to whom they institute a procession and sing songs in honor of the pudenda, it would be the most shameful action. But Dionysus, in whose honor they rave in bacchic frenzy, and Hades, are the same." Although this has usually been interpreted (by Schleiermacher, Lassalle, and Schuster) to mean that the excesses practiced in these ceremonies will be atoned for hereafter, since Dionysus under whose name they are carried on is identical with Pluto, the god of the lower world, Pfleiderer, interpreting it in a wholly different spirit, believes it to mean that these rites, although in themselves considered they would be most shameful, nevertheless have at least a partial justification from the fact that they are celebrated in honor of Dionysus, because since Dionysus and Pluto are the same, the

rites are really a symbolism expressing the power of life over death and the indestructibility of life even in death. These vile phallus songs are in fact songs of triumph of life over death (Pfleiderer, p. 28). Although somewhat far-fetched, this is a possible interpretation of this obscure passage. This explanation is perhaps not more strained than the others that have been given (see below, frag. 127, crit. note). Granting it, and granting that Heraclitus here expresses a certain sympathy with, or at least does not express condemnation of the Mysteries, what follows? Surely, Pfleiderer would not seriously ask us to conclude from a single passage friendly to the religion of the Mysteries, that Heraclitus' whole philosophy or any part of it was drawn from them.

But this fragment has another and more important use for Pfleiderer. In the religious truth here expressed of the identity of Dionysus and Hades, that is, the identity of life and death, he finds the germ of all the Heraclitic philosophy. But the serious question immediately arises whether the philosophy of opposites grew out of this identity, or whether this identity was merely another illustration of the law of opposites. As Pfleiderer has produced no sufficient reason for believing differently, the natural conclusion is that, as elsewhere we find the unity of day and night, up and down, awake and asleep, so here we have the unity of the god of death and the god of life, as another illustration of the general law. To reverse this and say that in this particular antithesis we have the parent of all antitheses is very fanciful. Still further, we should infer from Pfleiderer's argument that the identity of Dionysus and Hades was a well known and accepted truth among the Mysteries, and that in the

above fragment we find it in the very act of passing into the philosophy of the Ephesian. How much truth is there in this? So little that there is no record of the identity of these two gods before the time of Heraclitus. Later, to be sure, something of the kind appears. Dionysus represented at least five different gods, and in different times and places seems to have been identified with most of the principal deities. In Crete and at Delphi we hear of Zagreus, the winter Dionysus of the lower world. No doubt other instances might be shown where Dionysus was brought into some relation or other with a chthonian deity. But Heraclitus, if he had wished to develop a philosophy from the alternation of summer and winter and the mystic symbolism of life and death therein contained, would hardly have chosen so dubious an expression of it as the unity of Dionysus and Hades. We have no reason to regard this as anything else than one of the many paradoxical statements which he loved, of his law of opposites. Indeed, the genesis of this law is not so obscure that we need to force it out of a hidden mystic symbolism. Zeller in his introduction to Greek philosophy has well said that "philosophy did not need the myth of Kore and Demeter to make known the alternation of natural conditions, the passage from death to life and life to death; daily observation taught it" (Vol. 1, p. 60).

The intrinsic weakness of Pfleiderer's position is best seen when he attempts to pass to the doctrine of the flux. It taxes the imagination to see how the identity of life and death should lead to the universal principle *πάντα χωρεῖ καὶ οὐδὲν μένει*. Pfleiderer would have us believe that the eternal flux was a subordinate thought—a mere picture to help the mind to conceive

the primary metaphysical truth of the unity of opposites. We have already attempted to show that any explanation of the Heraclitic philosophy must be wrong which reduces the doctrine of the flux to a subordinate position. Here it is sufficient to add that if Heraclitus had been seeking a picture to illustrate the optimistic endurance of life even in death, and the rational unity and harmony of opposite powers, he could not possibly have chosen a more unfortunate figure than the ever-flowing river into which one cannot step twice. Pfleiderer, in saying that Heraclitus chose the picture of the evanescence of things to illustrate his law of opposites and the endurance of life, seems to have forgotten that on a previous page (above, p. 602) he said that the hopeless creed of the masses, against which the Ephesian was trying to establish the triumph of life, saw not too much permanence and constancy in the world, but too little.

We are forced, therefore, to conclude not only that Pfleiderer has failed to establish any especial dependence of Heraclitus upon the religion of the Greek Mysteries, but also that his supposed discovery that we have here a metaphysical philosophy developed from the material principle of the oscillating identity of life and death, is an assumption without basis in fact.

In redeeming the Ephesian from the charge of pessimism, Pfleiderer has done a good work. But here again he has gone too far, in finding not only a well grounded rational optimism in the doctrine of a world-ruling Order, but also a practical optimism in the idea of the *indestructibility of life*, an idea which, although it appears on every page of Pfleiderer's book, is not to be found in any saying of Heraclitus or in any record of his philosophy.

Section II.—Reconstructive.

I.

Having examined the four preceding fundamentally different views of the philosophy of Heraclitus, and having discovered that the opinions of modern critics on the tenor of this philosophy furnish a new and unexpected illustration of Heraclitus' own law of absolute instability, it remains to be considered whether it is possible to resolve, as he did, this general diversity into a higher unity, and in this case to verify his law that in all opposition there is harmony. If such a unity is sought as that attempted by Lassalle, Schuster, and Pfleiderer, it may be said at once that the task is impossible. All such ambitious attempts in constructive criticism in the case of Heraclitus are certain to result, as we have seen, in over-interpretation, and while they may leave a completed picture in the mind of the reader, they do not leave a true one. Not only is such a unified view of the philosophy of the Ephesian unattainable, but it is unnecessary. It is quite certain that had we before us his original book in its entirety, we should find therein no fully consistent system of philosophy. Yet it is just this fact that modern critics forget. While they point out errors and contradictions by the score in the books of their fellow critics, they allow for no inconsistencies on the part of the original philosopher. Presuppositions of harmony between all the sentences of an ancient writer have led to much violence of interpretation. Our interest in Heraclitus is not in his system as such, but in his great thoughts which have historic significance. These we should know, if possible, in their

original meaning and in their connection with preceding and succeeding philosophy. Before concluding this introduction, then, it will be of advantage to recapitulate the results of the foregoing criticism, and to place together such conclusions concerning the chief Heraclitic thoughts as we have drawn either from the agreement or the disagreement of the various critics.

We shall best understand Heraclitus if we fix well in mind his immediate starting-point. As we found above in the examination of Pfleiderer's position (p. 606), the Ephesian philosopher was first and primarily a *preacher*. To him the people almost without exception, were blind, stupid, and beastly. Heraclitus hated them. They got no farther than crude sense perception (cp. frags. 4, 6, 3), failing not only to recognize the invisible harmony of the changing world, but even the change itself (cp. frag. 2). They believed things were fixed because they appeared so at first sight. They preferred the lower passions to the higher senses (cp. frag. 111). He is from first to last a misanthrope. He despises the people, yet as if constrained by a divine command, he must deliver his message (cp. frags. 1, 2). To understand Heraclitus we must free our minds from conceptions of every other Greek philosopher, except, perhaps, his fellow Ionians. Never afterwards did philosophy exhibit such seriousness. We can no more imagine Heraclitus at Athens than we can think of Socrates away from it. Although, as we shall see, the philosophy of Plato stood in vital connection with that of Heraclitus, no contrast could be greater than the half playful speculative style of the former, and the stern, oracular and dogmatic utterances of the latter. We shall find no parallel except in Jewish literature. Indeed, Heraclitus was a pro-

phet. As the prophets of Israel *hurled* their messages in actual defiance at the people, hardly more does the Ephesian seem to care how his words are received, if only he gets them spoken. Not more bitter and misanthropic is Hosea in his denunciation of the people's sins (cp. ch. iv. 1, 2 ff.), than is our philosopher in his contempt for the stupidity and dullness of the masses. At the very opening of his book he says, from his lofty position of conscious superiority: "This Law which I unfold, men insensible and half asleep will not hear, and hearing, will not comprehend" (frag. 2; cp. frags. 3, 5, 94, 95).

Now what was the prime error of the people which so aroused the Ephesian, and what was the message which he had to deliver to them? Zeller is wrong in saying (Vol. 1, p. 576) that, according to Heraclitus, the radical error of the people was in attributing to things a permanence of being which they did not possess. In no passage does he censure the people for this. What he blames them for is their *insensibility*, for looking low when they ought to look high—in a word, for blindness to the Divine Law or the Universal Reason (frags. 2, 3, 4, 51, 45, 14). He blames them for not recognizing the beauty of strife (frag. 43), and the law of opposites (frag. 45). He blames them for their grossness and beastliness (frags. 86, 111). Finally, he blames them for their immorality (frag. 124), their silliness in praying to idols (frag. 126), and their imbecility in thinking they could purify themselves by sacrifices of blood (frag. 130). We see therefore how wholly impossible it is to understand Heraclitus unless we consider the ethical and religious character of his mind. Thus Zeller, in as far as he has attempted to give us a picture of Heraclitus'

system, has failed by starting with the doctrine of the flux and overlooking the religious motive. This is not to say, as Pfleiderer has done, that the flux was merely a negative teaching. Next to the recognition of the Eternal Law, it was the most positive of his teachings, and was the ground of his influence upon subsequent thought. As such it is of chief interest to us; but as far as we wish to get a picture of Heraclitus himself, we must think first of his religious and ethical point of departure. Thus the content of Heraclitus' message to his countrymen was *ethical.* It was a call to men everywhere to *wake up*, to purify their *βαρβάρους ψυχάς*, and see things in their reality.

What now was this reality which he with his finer insight saw, but which ruder souls were blind to? This brings us to the theoretical side or the philosophical content of Heraclitus' message. Here comes in the contribution of Teichmüller, who, as we saw, clearly pointed out that the great new thought of the Ephesian was the unity *in* the manifold, as opposed to the unity over against the manifold, taught by Xenophanes. It was the unity of opposition, the harmony of strife. It was Order immanent in ceaseless change. To use a phrase of Campbell's, "The Idea of the universe implies at once absolute activity and perfect law" (Plat. Theaet. Appendix, p. 244). This was the central thought of Heraclitus, "the grandeur of which," says Campbell, "was far beyond the comprehension of that time." But, it may be said, if we have rightly apprehended Heraclitus' position as a prophet and preacher, this was rather strong meat to feed the masses. But the *πολλοί* with Heraclitus was a very broad term. It included everybody. The arrogance of this man was sublime. Neither Homer nor

Hesiod nor Pythagoras nor Xenophanes escaped his lash (cp. frags. 16, 17, 119, 114). He had especially in mind the so-called "men of repute," and said they were makers and witnesses of lies (cp. frag. 118). The whole male population of Ephesus, he said, ought to be hung or expelled on account of their infatuation and blindness (cp. frag. 114). Addressing such an audience, indeed, his message had to be pitched high. We have in the Ephesian sage a man who openly claimed to have an insight superior to all the world, and the history of thought has vindicated his claim. Furthermore, it must be remembered that Heraclitus did, in a measure, try to make the world-ruling Law intelligible. He pictured it now as Justice, whose handmaids, the Erinyes, will not let the sun overstep his bounds (frag. 29); now as Fate, or the all-determining Destiny (Stobaeus, Ecl. i. 5, p. 178; cp. frag. 63); now as simple Law (frags. 23, 91), now as Wisdom (frag. 65), intelligent Will (frag. 19), God (frag. 36), Zeus (frag. 65). Respecting the latter term he expressly adds that it is misleading. So we see that Heraclitus did what some modern philosophers have been blamed for doing—he put his new thoughts into old religious formulas. But it was more justifiable in the case of the Ephesian. He did so, not to present a semblance of orthodoxy, but to try to make his idea intelligible. In fact, Heraclitus, no less than Xenophanes, was a fearless, outspoken enemy of the popular anthropomorphisms. "This world, the same for all," he says, "neither any of the gods nor any man has made, but it always was, and is, and shall be, an ever living fire, kindled and quenched according to law" (frag. 20; cp. frag. 126).

At this point it is natural to ask ourselves what,

more exactly considered, Heraclitus meant by his Universal Order, his Divine Law, κοινὸς λόγος, etc. This inquiry fair criticism will probably not allow us to answer more concisely than has already been done. We have found ample reason for rejecting the notion that it was of a logical nature, or any objectification of that which is inherent in human thought. Yet it was not without human attributes. As fiery essence, it was identified with the universe and became almost material. As Order, it approached the idea of pure mathematical Relation or Form (cp. frag. 23, and Zeller, Vol. 1, p. 628, 3, and 620). As Wisdom, it was pictured as the intelligent power or efficient force that produces the Order. When we reflect what difficulty even at the present day we find in answering the simple question, What is Order? we are less surprised to find that the Ephesian philosopher did not always distinguish it from less difficult conceptions. We are, however, surprised and startled at the significance of the thought which this early Greek so nearly formulated, that the one permanent, abiding element in a universe of ceaseless change is mathematical relation. At any rate, while recognizing the want of perfect consistency and coördination in Heraclitus' system here, we shall be helped by keeping this in mind, that the system was pure pantheism. Too much stress cannot be laid upon Teichmüller's exposition of the history of the idea of Transcendent Reason, which first arose, not in Heraclitus, but in Anaxagoras. To the latter belongs the credit or the blame, whichever it may be, of taking the first step towards the doctrine of immateriality or pure spirit, which has influenced not only philosophy, but society to its foundations even to the present day. Heraclitus was guiltless of it. To

him the world intelligence itself was a part of the world material—itself took part in the universal change.

In close connection with the Heraclitic Universal Order stands the doctrine of *strife* as the method of the evolution of the world, and the doctrine of the harmony and ultimately the unity of opposites—thoughts which were not only central in Heraclitus' system, but which, being too advanced for his time, have waited to be taken up in no small degree by modern science. It is unnecessary to repeat here the explanations of Schuster (above, pp. 574, 575), and particularly of Teichmüller (above, p. 586), which we found to indicate the correct interpretation of these thoughts. These principles are to Heraclitus the mediation between absolute change and perfect law. That which appears to the senses as rest and stability is merely the temporary equilibrium of opposite striving forces. It is harmony by tension (cp. frags. 45, 43, 46). This law, elementary in modern physics, is yet, as we shall presently see, not the whole content of the Heraclitic thought, although it is its chief import. But in the equilibrium of opposite forces we have at least relative rest, not motion. And of molecular motion Heraclitus knew nothing. How then did he conceive of apparent stability as absolute motion ? This question supposes more exactness of thought than we look for in the Ephesian. The eternal flux was more generally conceived as absolute *perishability*. Nothing is permanently fixed. All is involved in the ceaseless round of life and death, growth and decay. Strictly, however, there is no contradiction here, since the rest of balanced forces is only relative rest. It is possibly not going too far to accept an illustration given by Ernst Laas (Idealismus u. Positivismus 1, p. 200) of Heraclitus'

conception of absolute change under the dominion of law. He compares it to the actual path of our planets, which move neither in circles nor in exact ellipses, but under the influence of the attractive forces of moons and of other planets, or of comets, continually change both their course and their velocity, and yet all according to law.

In addition to the explanations now given, however, there is something more to be said concerning the unity or sameness of opposites. This teaching is very prominent in the Heraclitic fragments (cp. frags. 35, 36, 39, 43, 45, 46, 52, 57, 58, 59, 67, 78). This prominence was no doubt less in the original work, as the paradoxical character of these sayings has encouraged their preservation. But all the critics have failed to notice that we have in these fragments two distinct classes of oppositions which, though confused in Heraclitus' mind, led historically into different paths of development. The first is that unity of opposites which results from the fact that they are endlessly passing into one another. It must not be forgotten that this is a purely physical opposition, as has been pointed out by Zeller, Schuster and others, in refutation of the opinion of Lassalle, who fancied that he had found here a Hegelian logical identity of contradictories. As examples of this class of oppositions may be mentioned the identity of day and night (frag. 35), gods and men (frag. 67), alive and dead, asleep and awake (frag. 78). The identity of these oppositions means that they are not in themselves abiding conditions, but are continually and reciprocally passing into one another. As Heraclitus plainly says, they are the same because they are reciprocal transmutations of each other (frag. 78). But now we have another

class of opposites to which this reasoning will not apply. "Good and evil," he says, "are the same" (frag. 57). This is simply that identity of opposites which developed into the Protagorean doctrine of *relativity*. The same thing may be good or evil according to the side from which you look at it. The passage from Hippolytus (Ref. haer. ix. 10; cp. frag. 52, sources) states the doctrine of relativity as plainly as it can be stated. "Pure and impure, he [Heraclitus] says, are one and the same, and drinkable and undrinkable are one and the same. 'Sea water,' he says, 'is very pure and very foul, for while to fishes it is drinkable and healthful, to men it is hurtful and unfit to drink.'" (Compare the opposition of just and unjust, frag. 61; young and old, frag. 78; beauty and ugliness, frag. 99; cp. frags. 104, 98, 60, 61, 51, 53.) This simple truth is so prominent in the Heraclitic sayings that we see how Schuster could have mistaken it for the whole content of the theory of opposites and ignored the more important doctrine of the other class. We see further that Plato's incorrect supposition that the Protagorean subjectivism was wholly an outgrowth of the Heraclitic flux, resulted from his insufficient acquaintance with the Ephesian's own writings. It was a characteristic of Heraclitus that, in a degree surpassing any other philosopher of antiquity, and comparable only to the discoveries of Greek mathematicians and of modern physical philosophers, he had an insight into truths beyond his contemporaries, but he knew not how to coördinate or use them. Having hit upon certain paradoxical relations of opposites, he hastened to group under his new law all sorts of oppositions. Some that cannot be included under either of the above classes appear in a passage from Aristotle

(de Mundo, 5, p. 396 b 12; cp. frag. 59, sources; cp. Eth. Eud. vii. 1, p. 1235 a 26; frag. 43), where in the case of the opposites sharps and flats, male and female, the opposition becomes simple correlation and the unity, harmony.

The order of treatment brings us now to the Heraclitic flux, but we have been compelled so far to anticipate this in discussing the Universal Order and the Law of Opposites that but one or two points need be considered here. As we have seen in the study of Schuster and Teichmüller, the Heraclitic doctrine of the flux was a thoroughly radical one. Heaven and earth and all that they contain were caught in its fatal whirlpool. It exempted no immortal gods of the poets above us, no unchangeable realm of Platonic ideas around us, no fixed Aristotelian earth beneath us. It banished all permanence from the universe, and banished therewith all those last supports which men are accustomed to cling to. It introduced alarm into philosophy, and set men, even to the present day, asking, What can be saved from this general wreck? What is there absolutely permanent in the universe? This question, as we have seen, did not trouble Heraclitus himself, for, consistently or inconsistently, he had a foundation rock in his Universal Law, Reason or Order, which was his theoretical starting-point. Furthermore, concerning the flux, it is doubtful whether he ever pictured to himself such absolute instability as his words imply.

But we are tempted to ask, Is his system here really, as it first appears, inconsistent? Mr. Borden P. Bowne in his Metaphysics (p. 89) says that the Heraclitic theory of change thus extremely conceived "is intelligible and possible only because it is false."

Let us look at Mr. Bowne's argument. He has first shown in the same chapter that the Eleatic conception of rigid being without change is impossible, since in a world of absolute fixity, even the illusion of change would be impossible. Furthermore, he has shown that the vulgar conception of changeless being with changing states is untenable, since the "state of a thing expresses what the thing is at the time." Changing states would be uncaused and undetermined except as the being changes. There can be therefore no fixed useless core of being. In general there is no changeless being. All is change, all is becoming. Is there then, he asks, any permanence or identity whatever, or is the extreme Heraclitic position true? It is false. Why? Because, as in a world of Eleatic fixity, even the illusion of change would be impossible, so in a world of absolute change, even the appearance of rest would be impossible. There must be some abiding factor, that change may be known as change. There must be something permanent somewhere to make the notion of flow possible. This permanent something Mr. Bowne finds in the knowing subject—the conscious self. Having proceeded plainly up to this point, here he becomes mystical. The permanence of the conscious self, he continues, does not consist in any permanent substance of the soul. The soul forever changes equally with other being. The permanence consists in memory or self-consciousness. "How this is possible," he says, "there is no telling." The permanence and identity of the soul consists, however, only in its ability "to gather up its past and carry it with it."

In this argument, Mr. Bowne's first fallacy is in saying that in a world of absolute change there must

be some permanent factor in order that the change itself may be known. This is meaningless. Permanent as regards what? Permanence as regards other moving factors is simply relative difference of change. Mr. Bowne seems to have committed the primitive error of supposing that because all things seem to move, he alone is fixed—like the earth in the Ptolemaic astronomy. According to his argument, if he were in a moving car and should meet another moving car, the perception of movement would be impossible. His reasoning assumes that by absolute change is meant uniform change all in one way, which would not be change at all, but absolute fixity. *Difference* is the essential element in change, and difference is all that is necessary to the idea of change. The assumption of permanent personality in order to make change itself possible is unnecessary. Mr. Bowne says that what constitutes permanence in the conscious self is its ability to gather up its past and carry it with it. But a stratifying rock or growing tree gathers up its past and carries it with it. But the apparent permanence in the case of the rock or tree is a temporarily abiding *form* or temporarily abiding spacial relations. The apparent permanence of personality may similarly consist wholly in a temporarily abiding form or relation, must in fact consist in this, since Mr. Bowne rejects any abiding soul substance. But temporarily abiding relations, the extreme Heracliteans do not deny, certainly not Heraclitus, to whom apparent rest was due to the temporary equilibrium of opposite balancing forces. We conclude, therefore, that Mr. Bowne's charge of falsity against the theory of the Heraclitic flux is not well substantiated. Here as ever we see the difference between modern and

ancient philosophy. The former looks within, the latter without. Mr. Bowne seeks the abiding within himself. Heraclitus looked away from himself to the Universal Order without, which determined all things and himself.

But though the Heraclitic absolute flux is vindicated from objections of the above character, the question still remains unanswered whether the doctrine is consistent with his conception of absolute Order. Did not Heraclitus make the common mistake of hypostasizing law? Did he not conceive of law as something by which the action of things is predetermined, rather than as a mere abstraction from the action of things? No doubt he did even worse than this, for he ascribed to his *κοινὸς λόγος*, attributes which led Bernays and Teichmüller to believe that it was a self-conscious being, (a conclusion questioned by Zeller, Vol. 1, p. 609, 3). But yet again he saved his consistency here by identifying his Absolute with fire and thereby bringing it after all into the all-consuming vortex of endless change. But in the face of this all-embracing flux, the one idea which stands out most prominent in Heraclitus is the deep rationality of the world—the eternal Order. Nor in the last analysis are these two at variance, for any world must be rational to the beings in it, for the rationality of the world to us is only our adaptation to the world, which is involved in the very fact of our existence.

Concerning the cosmogony, it is worth while to recall the suggestive thought contained in the *χρησμοσύνη* and *κόρος* of Heraclitus. In our examination of Schuster's work we found reason to believe that the word *χρησμοσύνη*, which we may render "craving" or "longing," was used by the Ephesian to denote the charac-

ter of the impulse or motive force by which the primitive world matter or fire evolved itself into the world of individual things. The records are too meagre to warrant much enlargement upon this idea; nevertheless it is important historically and in itself interesting. It is the beginning of that line of thought which finds the analogy to the original motive or creative power of the universe, not in man's intellectual but in his emotional nature, not in pure thought but in pure desire. It is opposed to the conception of Aristotle that the absolute first mover is pure intellect, the thought of thought (*νόησις νοήσεως*), and to the modern German enlargement of the same which began with the intellectual monads of Leibniz. On the other hand, it is in agreement with the idea brought out by Plato in his Symposium, the idea of Love as the source of development and immortality, and it reminds us later of Plotinus, who refuses to predicate thought or reason of the One but identifies it with the Good. The Heraclitic-Platonic notion is no less anthropomorphic than the Aristotelian-Leibnizian; but if the human mind must furnish forth some faculty to be singly hypostasized into God, we much prefer the richer emotional side to that of pure dry intellect or reason.

We come now to the Heraclitic ethics, the freshest and most vital part of his philosophy, but most misunderstood by all the critics. The practical ethical rule with Heraclitus is to follow the law of the state, which again is dependent upon the Divine Law (frags. 91, 100). From his standpoint this agrees with his injunction to live according to Nature (frag. 107). More broadly stated, men should follow the Universal as opposed to individual whims. "The Law of Reason is common, but the majority of people live as though

they had an understanding of their own" (frag. 92). This leads us directly to the theoretical ethical principle which lay at the root of all Heraclitus' philosophy, and which we have outlined above (p. 617) in defining his starting point as that of a preacher and prophet. The highest good was *not* contentment (*εὐαρέστησις*), a statement taken from a single indefinite passage in Clement of Alexandria (Strom. ii. 21, p. 417; Clement is followed by Theodoretus, iv. p. 984, ed. Halle), and which, though adopted by Zeller, is as silly and impossible as the better authenticated statement that Heraclitus wept over everything. Such an ethical principle is at variance with every sentence of the Ephesian. He continually exhorts men, as we have seen, to arise, get out of their lethargy and wake up. His most pungent sarcasm is directed against the people who are in a state of indifference, sleepiness, contentment (frags. 2, 3, 5, 94, 95, etc.). The highest good with Heraclitus, therefore, is the greatest intellectually *activity*, the greatest *receptivity* to the divine reason around us, the greatest freedom from individual peculiarities and the greatest possession of that which is universal. "Human nature," he says, "does not possess understanding, but the divine does" (frag. 96). We must look away from ourselves to Nature around us. We must follow the universal Reason therein expressed. Proximately for men this is best found in the common, the normal, the customary, finally therefore in public law.

It will thus be noticed that we have in Heraclitus an emphatic expression of the type of ethics peculiar to the Greeks. Of the individual he thought little. "To me one is ten thousand if he be the best" (frag. 113). He blamed the Ephesians for their declaration

of democracy (frag. 114). He would not have been able to appreciate those modern systems of ethics which make a moral law out of individual conscience and justify actions by good intentions. Heraclitus, as well as psychologists of recent times, seemed to appreciate the dangers of self-involution. His whole system is a protest against individual intensification. He will not have men roll themselves into a cocoon of a single system, or revolve in the circle of a single set of ideas. He will have them throw themselves open to the common light, keep every sense open and receptive to new impressions, and thereby attain truth, which is found in the universal alone.

The optimism which Pfleiderer justifies for Heraclitus does not stand in contradiction to the misanthropy that we have found to characterize him. His optimism was thoroughly Leibnizian. It was reasoned optimism, resulting in the strong conviction that the world is good, rational and orderly. Most men, to be sure, are fools, but it is their own fault, as they will not put themselves in right relation to the world. Gottlob Mayer, in a pamphlet entitled "Heraklit von Ephesus und Arthur Schopenhauer," has been at pains to prove that Heraclitus is a Schopenhauer pessimist. We cannot regard his attempt as successful. Our study of the Ephesian philosopher in the preceding pages has shown nothing more clearly than that the logical result of his metaphysics is not, as this author claims, pessimism, but quite the opposite. None of the passages which he cites (cp. frags. 86, 55, 84, 66, 20, 111) can be made to yield any pessimism beyond misanthropy, unless possibly the one from Lucian (Vit. Auct. c. 14,—*ΩΝΗΤΗΣ. τί γὰρ ὁ αἰών ἐστιν; ΗΡΑΚΛΕΙΤΟΣ. παῖς παίζων, πεσσεύων, διαφερόμενος*, cp. frag.

79), where Time is compared to a child at play, now arranging, now scattering the pebbles. And yet nothing is conclusive from this. It refers evidently to the periodic creation and destruction of the world. Whether this world building is a pastime of Jove, or the product of fate or of love, makes no difference in this case, provided only the resulting world is one well disposed and rational.

II.

What has given rise to the reviving interest in Heraclitus attested by the monographs which have lately appeared? The modern world hardly hopes to get any new light from his oracular sayings gathered in mutilated fragments from Philo and Plutarch, from Clement and Origen. Such unhoped for light, however, as our introductory study has shown, may for some minds be found breaking in after all. But the interest in the philosopher of Ephesus is historical. The new discovery of the present half century is that the way to study philosophy is to study its history, and especially its genesis. The passion for origins has carried the interest back to Greek philosophy, and finally back to the beginnings of Greek philosophy. But there is still another reason for going back. In the confusion arising from the fall of the idealistic philosophy in Germany, it was first thought that it would be necessary to return to Kant and secure a new footing; not that any new light was seen emanating from Kant, but error having arisen, it was necessary to trace it to its source.

This movement has neither been successful nor does it promise to be. In fact, there is a certain weariness in philosophy of the whole modern subjective method.

The result has been that thinkers have turned away from it to the one objective side of modern philosophy, namely, the sciences. Those, however, who still retain their love of philosophy in its larger sense, are going back farther than Kant. They see that the whole Hume-Kantian-Fichtean movement was a digression, a sort of branch road, which to be sure had to be explored before philosophy could go on in safety, but which was found to lead nowhere in particular, and that, having thanked these investigators for their services rendered, we may decline to concern ourselves further with this digression, but go on with our search for objective results. In this search our starting point must be from that philosophy which is most free from this whole subjective tendency. Such is the philosophy of Greece. Considering therefore that the introspective method has not proved so fruitful as was hoped, and that it is at least more modest if not more rational to regard man as a part of Nature, rather than Nature as a part of man, students of philosophy are turning their attention to the Greek philosophers where the freer and more ingenuous conception rules.

These two causes, therefore, the former, the passion for studying the origin and development of thought and the connection of different systems of thought, the latter, the need of disinfecting our minds from all the germs of a pathological introspective habit, and putting ourselves as an experiment in the position of those who took it for granted that Nature was larger than man, have led us back to Greek philosophy and especially to its sources.

In either of these aspects Heraclitus is important. He is a perfect, by all means the most perfect, illustration of those qualities which are usually supposed to

characterize the Greek mind, namely, receptivity, unprejudiced freedom of thought, love of order, and trustful confidence in the unity of man and Nature. Of all the Greek schools these qualities were best represented by the Ionian thinkers who, coming before what has been called "the fall of man in Socrates," were free from the later dialectical disturbances. And of the Ionians, Heraclitus, the last, best incorporates them. But it is in the other aspect that the philosopher of Ephesus is most important, namely, in the origin and history of ideas. Let us notice summarily what has come from him.

To Heraclitus we trace the philosophy of change, prominent in subsequent Greek philosophy as γιγνόμενον, the indirect cause of the counter movement of Socrates and Plato with its powerful determining influences, central in modern times as *motion* in the philosophy of Hobbes and the ground principle in the important system of Trendelenburg, and finally in a logical transformation, prominent in both German and English thought as Werden or Becoming. To Heraclitus we trace the notion of Relativity, the central point in the doctrine of the Sophists, which by withdrawing every absolute standard of truth, threatened to destroy all knowledge and all faith, and which sent Socrates searching for something permanent and fixed in the concepts of the human mind, and so led to the finished results of Plato and Aristotle. To Heraclitus we trace some of the fundamental doctrines of the Stoics, namely, their abrogation of the antithesis of mind and matter and their return to pre-Socratic monism, their conception of Nature as larger than man and his complete subjection to it, and finally their doctrine of the future conflagration of the world, later an influential factor in Christianity.

These were the thoughts which were most important in their determining influence upon subsequent philosophy. The following, while in themselves no less important, were less directly involved in the history of opinion. Of these the first is the notion of Law and Order absolute and immanent in the world, an idea so large that no Greek follower could grasp it, and yet vital to Heraclitus' system, for without it his philosophy becomes the philosophy of desperation, the source among the ingenuous Greeks of the nihilism of Gorgias or the universal doubt of the skeptics, and among the brooding moderns the source of the pessimism of Schopenhauer. To Heraclitus again we trace, as Teichmüller has shown, the closely related doctrine of the immanence of God in the world, so that we have in him one source of the pantheistic systems. To Heraclitus, finally, we trace the physical law of opposites, the thought that all order and harmony and apparent permanence are the result of opposite tension, the balance of centrifugal and centripetal forces. Less involved in the history of philosophy, though most important to Heraclitus, and in themselves most interesting to us of modern times, are his great ethical thoughts which we have already outlined.

The determinative ideas of the Ephesian may be summed up in a word by saying that they represent all that way of thinking against which Socrates and Plato raised the whole weight of their authority. Without repeating here the facts, well enough known to everybody, of the Socratic reaction in Greek philosophy, we must sketch one or two phases of it in order to establish the influence and explain the final defeat of the Heraclitic philosophy. In Socrates, Plato, and Aristotle, philosophy underwent a change more radical

than any other in its history, a change that was ultimately to revolutionize all thought, and through its influence on Christian theology, to enter as a large determining element into all western civilization. Heraclitus is the representative of what philosophy was before that change.

Socrates said he could not understand the book of Heraclitus. That was not strange. The Ephesian could have told him the reason why. The man who could learn nothing from the fields and trees (see Plato's Phaedrus, p. 230), who spent all his time in the Agora conversing with other men about virtue, and who never seemed to realize that there was a world above the heads and under the feet of men, was not likely to understand the book of Heraclitus. Could the Ephesian philosopher have taken the Athenian logician out and given him a few lessons from Nature at first hand, could he have induced him to desist for a while from his boring into human intellects in search of a definition, and got his gaze lifted up to the clouds and stars, and put him in actual contact with the *περιέχον*, he would have been an apter scholar with the book. But it is quite impossible even in fancy to think of these two men together. The communer with Nature, the stern misanthropic sage and prophet of Ephesus had no points in common with the society-loving Athenian sophist. They were radically different, and on this difference hangs the secret of the development of philosophy for two thousand years. Socrates was not a Greek at all. He denied the most characteristic traits of his nation. He was a modern in many true senses. He was a curiosity at Athens, and consequently very much in vogue.

Socrates represents the birth of self-consciousness. In

practicing his maieutic art to this end, he little thought that he was giving the death-blow to the most beautiful trait of his countrymen, namely, the instinctive, the unconscious, the naïve. No doubt this new birth had to take place some time, but under Socrates' direction it was premature. The old methods were not yet dead. Here historians of philosophy err. They say the pre-Socratic philosophers of Nature had in vain tried to solve the problems of the world, and it was high time for a critical philosophy that should begin with man. In vain, indeed! Had the naturalists labored in vain when the foundation of the atomic philosophy had been laid in Abdera, that of mathematics in Italy, and a far-seeing metaphysics and ethics in Ephesus? Socrates and Plato took fright too easily at the Sophists. Their philosophy would have died with them. Not so that of Democritus, Pythagoras, and Heraclitus. Socrates was a professor of clear thinking. Clear thinking is in itself well, but two solid centuries of clear thinking from Descartes to Hegel have in modern times ended in failure. We long to know what *natural* thinking would have accomplished if it had been left an open field a while longer in Greece. Then again clear thinking was overdone. It was, to be sure, not Socrates' fault that his method was afterwards abused, but as a matter of fact it took in later history a pathological turn that has resulted in wide-spread evils. Over self-consciousness, too much inwardness and painful self-inspection, absence of trust in our instincts and of the healthful study of Nature, which in ethics are illustrated in modern questions of casuistry, and in philosophy in Cartesian doubt and the skepticism of Hume, characterize our worst faults. The philosophy and ethics of Heraclitus, as we have seen, stood in vital opposition to all these traits.

But there was another respect in which the fall of man took place in Socrates. The love of beauty and form, and particularly beauty of the human body, characterized all the Greeks until Socrates, but characterizes modern people in a relatively small degree. Socrates cared nothing for outward beauty, but to the surprise of his fellow-citizens laid all the emphasis upon moral beauty. (We will say he was too large hearted to have had a personal motive for so doing.) It may be that the Greeks estimated physical beauty relatively too high, but the rebound has been too great. Caught up by the genius of Plato and intensified by the tenor of his philosophy, and met six centuries later in Alexandria by a powerful current of the same tendency from Judea, it effected the complete destruction of the Greek idea, and with it of course of Greek art. In the medieval church, inherited moral deformity was a *sin* of such extreme import, that for it a man was to be forever damned; but inherited physical deformity was not only not a sin, but often a blessing, teaching him as it did the relative worthlessness of the earthly life and body. So far was the Greek idea reversed that the body, instead of being the type of beauty, became the type of impurity, and from being the support of the soul, became its contaminator. The "flesh," indeed, was the symbol of evil. The results in modern life are only too well known. Among them may be mentioned the loss of appreciation of the worth of the present physical life in itself, failure to recognize the close connection of soul and body, and that the health of the former depends on the health of the latter, resulting in all the strange devices to secure the welfare of the soul in the face of persistent disregard of the laws of physical

health, or in such attempts as that of sustaining the moral status of a community where all hygienic laws are violated. This idea has been ground into the popular mind by so long education that modern educators find it a serious problem how to correct it. It is not merely physical education that is wanted, but a reconstruction of our notions about the relation of body and mind. The Socratic work must be in part undone, and we must get back more nearly to the pre-Socratic conception of *balance*, for to them physical ugliness was no less an evil than moral ugliness.

But there is still another aspect of the Socratic apostasy, as important as those we have mentioned, and so far-reaching in its effects that it determines modern thought even to the lowest ranks of society. In this movement begun by Socrates, but perfected by Plato and Aristotle, the central thought of the Heraclitic philosophy was denied, and denied with such power that now after twenty-two hundred years it hardly dares assert itself. We refer, of course, to the Platonic transcendentalism. It was designed to give the death-blow to Heraclitus, and it succeeded ultimately beyond the wildest hopes of its founders. Strictly it was begun by Anaxagoras. We have already seen with Teichmüller how the doctrine of transcendent reason gained its first characteristic, Pure Separation, in the Nous of Anaxagoras, its second, Identity, in the definitive work of Socrates. But it was Plato who elevated it into a great system and gave it to the world for a perpetual inheritance. Finally, Aristotle, as if the fates conspired to make this doctrine immortal, took it up and adapted it to unpoetical inductive minds. Heraclitus in a wonderful conception of the world had abolished every antithesis and enunciated a system of pure

monism. The Socratic school reversed his plan and set up a dualism of universal and particular, noumenon and phenomenon, mind and body, spirit and matter, which has dominated all philosophy, religion and literature.

It is with the origin of this dualism that we are concerned, not with the familiar history of its outcome, but yet we may recall what to the student of philosophy or even of history it is needless to more than mention, how this dualism fastened itself upon subsequent thought; how as realism and nominalism it divided the schoolmen; how as mind and matter it left Descartes in hopeless difficulty; how Spinoza founded a philosophy expressly to resolve it, but succeeded only by the artifice of terms; how Leibnitz solved the problem, though with too much violence, by use of the same boldness with which its founders established it; how Kant finally left the antithesis unexplained; how again as the material and immaterial it fixed itself in the psychology of Aristotle, who affirmed as the higher part of the human mind, the active Nous or principle of pure immateriality, cognizant of the highest things, identical with the divine Prime Mover, and immortal, thus constituting for man the highest glorification that he ever received from his own hand; how Thomas Aquinas, spokesman for a powerful church, adopted this psychology and fastened it upon the modern popular world; how finally, in the sphere of religion proper, the transcendentalism of Plato has grown into the belief in pure Spirit and spiritual existences, peopling heaven and earth, and holding communion with matter and body, though having absolutely nothing in common (if the paradox may be excused) with them. Such has been in part the wonderful expansion of the Platonic Idealism.

And what was all this for in the first place? It was raised primarily as a barrier against the dissolving power of the eternal flux of the Heracliteans. A philosophy had arisen in Greece that denied all permanence. Misunderstood by the Sophists and abused by Cratylus, it called out the protest of Socrates, at heart the sincerest man of his contemporaries. Man, impelled by that very faculty which connects him most closely with Nature, namely, the sense of dependence, demands something permanent and unchangeable, upon which he can base his laws, religion and philosophy. If he cannot find it in Nature or in Revelation, he will make it out of a part of himself. This is what Socrates and Plato did. Socrates, seeking the permanent for ethical motives, detesting Nature and failing to find there anything fixed and abiding, turned to man and man's manner of thinking. By analysis of thought he separated out general concepts which appeared to be the same for all. Plato, perhaps less in earnest than subsequent ages gave him credit for, hypostasized them, raised them into real *objective* existences, henceforth to become idols, convenient entities to fill all gaps in human reasoning, objects of the dreams of poets and the worship of the religious, archetypes from which a lazy philosophy could deduce the universe. How, we naturally ask, could this audacious piece of anthropomorphism, in which man deliberately took his own norms of thought, projected them outward, and elevated them into gods, impose itself upon the world as it did? There are two answers. First, it flattered men immensely, and like all anthropomorphisms, thereby won half the battle. Second, it did *not* succeed at once, but slumbered for four centuries, and finally, in the decadence of all systems of

philosophy and the breaking up of the old civilization, awakened to supply the groundwork of a religious revival. Platonism fell dead on the Greek world. Plato, and Aristotle as well, shot over the heads of their fellows. The philosophy of the Academy was a brilliant piece of speculation such as only the age of Pericles could call out. After that, philosophy fell back into the old ways. The Older Academy dragged out a short existence and died. Zeno, a Cypriote, but in his desire for unity more Greek than Plato, studied first with Polemo, head of the Academy, but disappointed with Platonism, turned back to Heraclitus. His school, as well as the Epicureans and Skeptics, returned to the Heraclitic monism. These schools loyally upheld for three centuries the Greek idea of the unity of man and Nature. But philosophy itself was doomed and fated to pass over into religion on the one hand and mysticism on the other. Platonism was admirably adapted to this end. In luxurious Alexandria, the weary inductive method of Aristotle, which the Ptolemies had instituted in the Museum, soon yielded to the fascinating lazy philosophy of Plato. Philo the Jew, Plutarch the moralist, Valentinus the Gnostic, Origen the Christian, all yielded to it in greater or less degree. In Plotinus it reached its full fruitage. Porphyry, his pupil, relates that he was ashamed of having a body and was careless of its needs, so anxious was he ecstatically to absorb his soul in the Supra-rational Transcendent One. Here we have a last consequence of the Socratic doctrine of mind. Here we have the extreme opposition to the naturalism of Heraclitus which considered man as a subordinate part of Nature. Greek philosophy ended with the triumph of Socrates and the defeat of Hera-

clitus. The wealth of Plato and Aristotle was the bequest that was handed over to the coming centuries. The Greek naturalists were forgotten. It was reserved for the present century to revive and vindicate them.

In what has been said in setting in relief the philosophy of Heraclitus, it is obvious that we have been concerned with but two or three aspects of that of Socrates and Plato, namely, its transcendental, idealistic and subjective character. It is not necessary to add that were we referring to other sides of it, as for instance, the undeniable importance of Socrates' contribution to ethics, and that of Plato to ethics and religion as well as to real scientific thought, the result would be very different. And of the Idealism itself, its very fascination and prevalence argue that it meets some want of human beings. It is poetry, to be sure, but as poetry it has been and will still be useful in saving men from the dangers of coarse materialistic thought.

Heraclitus of Ephesus on Nature.

I.—It is wise for those who hear, not me, but the universal Reason, to confess that all things are one.[1]

II.—To this universal Reason which I unfold, although it always exists, men make themselves insensible, both before they have heard it and when they have heard it for the first time. For notwithstanding that all things happen according to this Reason, men act as though they had never had any experience in regard to it when they attempt such words and works as I am now relating, describing each thing according to its nature and explaining how it is ordered. And some men are as ignorant of what

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Sources.—I.—Hippolytus, Ref. haer. ix. 9. Context:—Heraclitus says that all things are one, divided undivided, created uncreated, mortal immortal, reason eternity, father son, God justice. "It is wise for those who hear, not me, but the universal Reason, to confess that all things are one." And since all do not comprehend this or acknowledge it, he reproves them somewhat as follows: "They do not understand how that which separates unites with itself; it is a harmony of oppositions like that of the bow and of the lyre" (=frag. 45).

Compare Philo, Leg. alleg. iii. 3, p. 88. Context, see frag. 24.

II.—Hippolytus, Ref. haer. ix. 9. Context:—And that Reason always exists, being all and permeating all, he (Heraclitus) says in this manner: "To this universal," etc.

Aristotle, Rhet. iii. 5, p. 1407, b. 14. Context:—For it is very hard to punctuate Heraclitus' writings on account of its not being clear whether the words refer to those which precede or to those which follow. For instance, in the beginning of his work, where he says, "To Reason existing always men make themselves insensible." For here it is ambiguous to what "always" refers.

Sextus Empir. adv. Math. vii. 132.—Clement of Alex. Stromata, v. 14, p. 716.—Amelius from Euseb. Praep. Evang. xi. 19, p. 540.—Compare Philo, Quis. rer. div. haer. 43, p. 505.—Compare Ioannes Sicel. in Walz. Rhett. Gr. vi. p. 95.

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[1] The small figures in the translation refer to the critical notes, pp. 674 ff.

they do when awake as they are forgetful of what they do when asleep.[2]

III.—Those who hear and do not understand are like the deaf. Of them the proverb says: "Present, they are absent."

IV.—Eyes and ears are bad witnesses to men having rude souls.

V.—The majority of people have no understanding of the things with which they daily meet, nor, when instructed, do they have any right knowledge of them, although to themselves they seem to have.

VI.—They understand neither how to hear nor how to speak.

III.—Clement of Alex. Strom. v. 14, p. 718. Context:—And if you wish to trace out that saying, "He that hath ears to hear, let him hear," you will find it expressed by the Ephesian in this manner, "Those who hear," etc.

Theodoretus, Therap. i. p. 13, 49.

IV.—Sextus Emp. adv. Math. vii. 126. Context:—He (Heraclitus) casts discredit upon sense perception in the saying, "Eyes and ears are bad witnesses to men having rude souls." Which is equivalent to saying that it is the part of rude souls to trust to the irrational senses.

Stobaeus Floril. iv. 56.

Compare Diogenes Laert. ix. 7.

V.—Clement of Alex. Strom. ii. 2, p. 432.

M. Antoninus iv. 46. Context:—Be ever mindful of the Heraclitic saying that the death of earth is to become water, and the death of water is to become air, and of air, fire (see frag. 25). And remember also him who is forgetful whither the way leads (comp. frag. 73); and that men quarrel with that with which they are in most continual association (= frag. 93), namely, the Reason which governs all. And those things with which they meet daily seem to them strange; and that we ought not to act and speak as though we were asleep (= frag. 94), for even then we seem to act and speak.

VI.—Clement of Alex. Strom. ii. 5, p. 442. Context:—Heraclitus, scolding some as unbelievers, says: "They understand neither how to hear nor to speak," prompted, I suppose, by Solomon, "If thou lovest to hear, thou shalt understand; and if thou inclinest thine ear, thou shalt be wise."

VII.—If you do not hope, you will not win that which is not hoped for, since it is unattainable and inaccessible.

VIII.—Gold-seekers dig over much earth and find little gold.

IX.—Debate.

X.—Nature loves to conceal herself.

XI.—The God whose oracle is at Delphi neither speaks plainly nor conceals, but indicates by signs.

XII.—But the Sibyl with raging mouth uttering things solemn, rude and unadorned, reaches with her voice over a thousand years, because of the God.

VII.—Clement of Alex. Strom. ii. 4, p. 437. Context :—Therefore, that which was spoken by the prophet is shown to be wholly true, "Unless ye believe, neither shall ye understand." Paraphrasing this saying, Heraclitus of Ephesus said, "If you do not hope," etc.

Theodoretus, Therap. i. p. 15, 51.

VIII.—Clement of Alex. Strom. iv. 2, p. 565.

Theodoretus, Therap. i. p. 15, 52.

IX.—Suidas, under word *ἀμφισβατεῖν. 'Αμφισβατεῖν. ἔνιοι τὸ ἀμφισβητεῖν. 'Ιωνες δὲ καὶ ἀγχιβατεῖν, καὶ ἀγχιβασίην* 'Ηράκλειτος.

X.—Themistius, Or. v. p. 69 (=xii. p. 159). Context :—Nature, according to Heraclitus, loves to conceal herself ; and before nature the creator of nature, whom therefore we especially worship and adore because the knowledge of him is difficult.

Philo, Qu. in Gen. iv. 1, p. 237, Aucher.: Arbor est secundum Heraclitum natura nostra, quae se obducere atque abscondere amat.

Compare idem de Profug. 32, p. 573 ; de Somn. i. 2, p. 621 ; de Spec. legg. 8, p. 344.

XI.—Plutarch, de Pyth. orac. 21, p. 404. Context :—And I think you know the saying of Heraclitus that "The God," etc.

Iamblichus, de Myst. iii. 15.

Idem from Stobaeus Floril. lxxxi. 17.

Anon. from Stobaeus Floril. v. 72.

Compare Lucianus, Vit. auct. 14.

XII.—Plutarch, de Pyth. orac. 6, p. 397. Context :—But the Sibyl, with raging mouth, according to Heraclitus, uttering things solemn, rude and unadorned, reaches with her voice over a

XIII.—Whatever concerns seeing, hearing, and learning, I particularly honor.[3]

XIV.—Polybius iv. 40. Especially at the present time, when all places are accessible either by land or by water, we should not accept poets and mythologists as witnesses of things that are unknown, since for the most part they furnish us with unreliable testimony about disputed things, according to Heraclitus.

XV.—The eyes are more exact witnesses than the ears.[4]

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thousand years, because of the God. And Pindar says that Cadmus heard from the God a kind of music neither pleasant nor soft nor melodious. For great holiness permits not the allurements of pleasures.

Clement of Alex. Strom. i. 15, p. 358.

Iamblichus, de Myst. iii. 8.

See also pseudo-Heraclitus, Epist. viii.

XIII.—Hippolytus, Ref. haer. ix. 9, 10. Context:—And that the hidden, the unseen and unknown to men is [better], he (Heraclitus) says in these words, "A hidden harmony is better than a visible" (= frag. 47). He thus praises and admires the unknown and unseen more than the known. And that that which is discoverable and visible to men is [better], he says in these words, "Whatever concerns seeing, hearing, and learning, I particularly honor," that is, the visible above the invisible. From such expressions it is easy to understand him. In the knowledge of the visible, he says, men allow themselves to be deceived as Homer was, who yet was wiser than all the Greeks; for some boys killing lice deceived him saying, "What we see and catch we leave behind; what we neither see nor catch we take with us" (frag. 1, Schuster). Thus Heraclitus honors in equal degree the seen and the unseen, as if the seen and unseen were confessedly one. For what does he say? "A hidden harmony is better than a visible," and, "Whatever concerns seeing, hearing, and learning, I particularly honor," having before particularly honored the invisible.

XV.—Polybius xii. 27. Context:—There are two organs given to us by nature, sight and hearing, sight being considerably the more truthful, according to Heraclitus, "For the eyes are more exact witnesses than the ears."

Compare Herodotus i. 8.

XVI.—Much learning does not teach one to have understanding, else it would have taught Hesiod and Pythagoras, and again Xenophanes and Hecataeus.

XVII.—Pythagoras, son of Mnesarchus, practised investigation most of all men, and having chosen out these treatises, he made a wisdom of his own—much learning and bad art.

XVIII.—Of all whose words I have heard, no one attains to this, to know that wisdom is apart from all.[5]

XIX.—There is one wisdom, to understand the intelligent will by which all things are governed through all.[6]

XX.—This world, the same for all, neither any of

XVI.—Diogenes Laert. ix. 1. Context:—He (Heraclitus) was proud and disdainful above all men, as indeed is clear from his work, in which he says, "Much learning does not teach," etc.

Aulus Gellius, N. A. praef. 12.

Clement of Alex. Strom. i. 19, p. 373.

Athenaeus xiii. p. 610 B.

Iulianus, Or. vi. p. 187 D.

Proclus in Tim. 31 F.

Serenus in Excerpt. Flor. Ioann. Damasc. ii. 116, p. 205, Meinek.

Compare pseudo-Democritus, fr. mor. 140 Mullach.

XVII.—Diogenes Laert. viii. 6. Context:—Some say, foolishly, that Pythagoras did not leave behind a single writing. But Heraclitus, the physicist, in his croaking way says, "Pythagoras, son of Mnesarchus," etc.

Compare Clement of Alex. Strom. i. 21, p. 396.

XVIII.—Stobaeus Floril. iii. 81.

XIX.—Diogenes Laert. ix. 1. Context:—See frag. 16.

Plutarch, de Iside 77, p. 382. Context:—Nature, who lives and sees, and has in herself the beginning of motion and a knowledge of the suitable and the foreign, in some way draws an emanation and a share from the intelligence by which the universe is governed, according to Heraclitus.

Compare Cleanthes H. in Iov. 36.

Compare pseudo-Linus, 13 Mullach.

XX.—Clement of Alex. Strom. v. 14, p. 711. Context:—Heraclitus of Ephesus is very plainly of this opinion, since he recognizes

the gods nor any man has made, but it always was, and is, and shall be, an ever living fire, kindled in due measure, and in due measure extinguished.[7]

XXI.—The transmutations of fire are, first, the sea; and of the sea, half is earth, and half the lightning flash.[8]

XXII.—All things are exchanged for fire and fire for all things, just as wares for gold and gold for wares.

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that there is an everlasting world on the one hand and on the other a perishable, that is, in its arrangement, knowing that in a certain manner the one is not different from the other. But that he knew an everlasting world eternally of a certain kind in its whole essence, he makes plain, saying in this manner, "This world the same for all," etc.

Plutarch, de Anim. procreat. 5, p. 1014. Context:—This world, says Heraclitus, neither any god nor man has made; as if fearing that having denied a divine creation, we should suppose the creator of the world to have been some man.

Simplicius in Aristot. de cael. p. 132, Karst.

Olympiodorus in Plat. Phaed. p. 201, Finckh.

Compare Cleanthes H., Iov. 9.

Nicander, Alexiph. 174.

Epictetus from Stob. Floril. cviii. 60.

M. Antoninus vii. 9.

Just. Mart. Apol. p. 93 C.

Heraclitus, Alleg. Hom. 26.

XXI.—Clement of Alex. Strom. v. 14, p. 712. Context:—And that he (Heraclitus) taught that it was created and perishable is shown by the following, "The transmutations," etc.

Compare Hippolytus, Ref. haer. vi. 17.

XXII.—Plutarch, de EI. 8, p. 388. Context:—For how that (scil. first cause) forming the world from itself, again perfects itself from the world, Heraclitus declares as follows, "All things are exchanged for fire and fire for all things," etc.

Compare Philo, Leg. alleg. iii. 3, p. 89. Context, see frag. 24.

Idem, de Incorr. mundi 21, p. 508.—Lucianus, Vit. auct. 14.

Diogenes Laert. ix. 8.

Heraclitus, Alleg. Hom. 43.

Plotinus, Enn. iv. 8, p. 468.—Iamblichus from Stob. Ecl. i. 41.

Eusebius, Praep. Evang. xiv. 3, p. 720.—Simplicius on Aristot. Phys. 6, a.

XXIII.—The sea is poured out and measured to the same proportion as existed before it became earth.[9]

XXIV.—Craving and Satiety.[10]

XXV.—Fire lives in the death of earth, air lives in the death of fire, water lives in the death of air, and earth in the death of water.[11]

XXVI.—Fire coming upon all things, will sift and seize them.

XXIII.—Clement of Alex. Strom. v. 14, p. 712 (= Eusebius, P. E. xiii. 13, p. 676). Context:—For he (Heraclitus) says that fire is changed by the divine Reason which rules the universe, through air into moisture, which is as it were the seed of cosmic arrangement, and which he calls sea; and from this again arise the earth and the heavens and all they contain. And how again they are restored and ignited, he shows plainly as follows, "The sea is poured out," etc.

XXIV.—Hippolytus, Ref. haer. ix. 10. Context:—And he (Heraclitus) says also that this fire is intelligent and is the cause of the government of all things. And he calls it craving and satiety. And craving is, according to him, arrangement (διακόσμησις), and satiety is conflagration (ἐκπύρωσις). For, he says, "Fire coming upon all things will separate and seize them" (= frag. 26).

Philo, Leg. alleg. iii. 3, p. 88. Context:—And the other (scil. ὁ γονορρυής), supposing that all things are from the world and are changed back into the world, and thinking that nothing was made by God, being a champion of the Heraclitic doctrine, introduces craving and satiety and that all things are one and happen by change.

Philo, de Victim. 6, p. 242.

Plutarch, de EI. 9, p. 389.

XXV.—Maximus Tyr. xli. 4, p. 489. Context:—You see the change of bodies and the alternation of origin, the way up and down, according to Heraclitus. And again he says, "Living in their death and dying in their life (see frag. 67). Fire lives in the death of earth," etc.

M. Antoninus iv. 46. Context, see frag. 5.

Plutarch, de EI. 18, p. 392.

Idem, de Prim. frig. 10, p. 949. Comp. pseudo-Linus 21, Mull.

XXVI.—Hippolytus, Ref. haer. ix. 10. Context, see frag. 24.

Compare Aetna v. 536: quod si quis lapidis miratur fusile robur, cogitet obscuri verissima dicta libelli, Heraclite, tui, nihil insuperabile ab igni, omnia quo rerum naturae semina iacta.

XXVII.—How can one escape that which never sets?[12]

XXVIII.—Lightning rules all.

XXIX.—The sun will not overstep his bounds, for if he does, the Erinyes, helpers of justice, will find him out.

XXX.—The limits of the evening and morning are the Bear, and opposite the Bear, the bounds of bright Zeus.

XXXI.—If there were no sun, it would be night.

XXVII.—Clement of Alex. Paedag. ii. 10, p. 229. Context:—For one may escape the sensible light, but the intellectual it is impossible to escape. Or, as Heraclitus says, "How can one escape that which never sets?"

XXVIII.—Hippolytus, Ref. haer. ix. 10. Context:—And he (Heraclitus) also says that a judgment of the world and all things in it takes place by fire, expressing it as follows, "Now lightning rules all," that is, guides it rightly, meaning by lightning, everlasting fire.

Compare Cleanthes H., Iovem 10.

XXIX.—Plutarch, de Exil. II, p. 604. Context:—Each of the planets, rolling in one sphere, as in an island, preserves its order. "For the sun," says Heraclitus, "will not overstep his bounds," etc.

Idem, de Iside 48, p. 370.

Comp. Hippolytus, Ref. haer. vi. 26.

Iamblichus, Protrept. 21, p. 132, Arcer.

Pseudo-Heraclitus, Epist. ix.

XXX.—Strabo i. 6, p. 3. Context:—And Heraclitus, better and more Homerically, naming in like manner the Bear instead of the northern circle, says, "The limits of the evening and morning are the Bear, and opposite the Bear, the bounds of bright Zeus." For the northern circle is the boundary of rising and setting, not the Bear.

XXXI.—Plutarch, Aq. et ign. comp. 7, p. 957.

Idem, de Fortuna 3, p. 98. Context:—And just as, if there were no sun, as far as regards the other stars, we should have night, as Heraclitus says, so as far as regards the senses, if man had not mind and reason, his life would not differ from that of the beasts.

Compare Clement of Alex. Protrept. II, p. 87.

Macrobius, Somn. Scip. i. 20.

XXXII.—The sun is new every day.

XXXIII.—Diogenes Laertius i. 23. He (scil. Thales) seems, according to some, to have been the first to study astronomy and to foretell the eclipses and motions of the sun, as Eudemus relates in his account of astronomical works. And for this reason he is honored by Xenophanes and Herodotus, and both Heraclitus and Democritus bear witness to him.

XXXIV.—Plutarch, Qu. Plat. viii. 4, p. 1007. Thus Time, having a necessary union and connection with heaven, is not simple motion, but, so to speak, motion in an order, having measured limits and periods. Of which the sun, being overseer and guardian to limit, direct, appoint and proclaim the changes and seasons which, according to Heraclitus, produce all things, is the helper of the leader and first God, not in small or trivial things, but in the greatest and most important.

XXXV.—Hesiod is a teacher of the masses. They suppose him to have possessed the greatest knowledge, who indeed did not know day and night. For they are one.[13]

XXXII.—Aristotle, Meteor. ii. 2, p. 355 *a* 9. Context:—Concerning the sun this cannot happen, since, being nourished in the same manner, as they say, it is plain that the sun is not only, as Heraclitus says, new every day, but it is continually new.

Alexander Aphrod. in Meteor. l. l. fol. 93 a.

Olympiodorus in Meteor. l. l. fol. 30 a.

Plotinus, Enn. ii. 1, p. 97.

Proclus in Tim. p. 334 B.

Compare Plato, Rep. vi. p. 498 B.

Olympiodorus in Plato, Phaed. p. 201, Finckh.

XXXIV.—Compare Plutarch, de Def. orac. 12, p. 416.

M. Antoninus ix. 3.

Pseudo-Heraclitus, Epist. v.

XXXV.—Hippolytus, Ref. haer. ix. 10. Context:—Heraclitus says that neither darkness nor light, neither evil nor good, are different, but they are one and the same. He found fault, therefore, with

XXXVI.—God is day and night, winter and summer, war and peace, plenty and want. But he is changed, just as when incense is mingled with incense, but named according to the pleasure of each.[14]

XXXVII.—Aristotle, de Sensu 5, p. 443 *a* 21. Some think that odor consists in smoky exhalation, common to earth and air, and that for smell all things are converted into this. And it was for this reason that Heraclitus thus said that if all existing things should become smoke, perception would be by the nostrils.

XXXVIII.—Souls smell in Hades.[15]

XXXIX.—Cold becomes warm, and warm, cold; wet becomes dry, and dry, wet.

XL.—It disperses and gathers, it comes and goes.[16]

Hesiod because he knew [not] day and night, for day and night, he says, are one, expressing it somewhat as follows: "Hesiod is a teacher of the masses," etc.

XXXVI.—Hippolytus, Ref. haer. ix. 10. Context:—For that the primal (Gr. πρῶτον, Bernays reads ποιητὸν, created) world is itself the demiurge and creator of itself, he (Heraclitus) says as follows: "God is day and," etc.

Compare idem, Ref. haer. v. 21.

Hippocrates, περὶ διαίτης i. 4, Littr.

XXXVIII.—Plutarch, de Fac. in orbe lun. 28, p. 943. Context:—Their (scil. the souls') appearance is like the sun's rays, and their spirits, which are raised aloft, as here, in the ether around the moon, are like fire, and from this they receive strength and power, as metals do by tempering. For that which is still scattered and diffuse is strengthened and becomes firm and transparent, so that it is nourished with the chance exhalation. And finely did Heraclitus say that "souls smell in Hades."

XXXIX.—Schol. Tzetzae, Exeget. Iliad. p. 126, Hermann. Context:—Of old, Heraclitus of Ephesus was noted for the obscurity of his sayings, "Cold becomes warm," etc.

Compare Hippocrates, περὶ διαίτης i. 21.

Pseudo-Heraclitus, Epist. v.—Apuleius, de Mundo 21.

XL.—Plutarch, de EI. 18, p. 392. Context, see frag. 41.

Compare pseudo-Heraclitus, Epist. vi.

XLI.—Into the same river you could not step twice, for other <and still other> waters are flowing.

XLII.—†To those entering the same river, other and still other waters flow.†

XLIII.—Aristotle, Eth. Eud. vii. 1, p. 1235 a 26. And Heraclitus blamed the poet who said, "Would

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XLI.—Plutarch, Qu. nat. 2, p. 912. Context:—For the waters of fountains and rivers are fresh and new, for, as Heraclitus says, "Into the same river," etc.

Plato, Crat. 402 A. Context:—Heraclitus is supposed to say that all things are in motion and nothing at rest; he compares them to the stream of a river, and says that you cannot go into the same river twice (Jowett's transl.).

Aristotle, Metaph. iii. 5, p. 1010 a 13. Context:—From this assumption there grew up that extreme opinion of those just now mentioned, those, namely, who professed to follow Heraclitus, such as Cratylus held, who finally thought that nothing ought to be said, but merely moved his finger. And he blamed Heraclitus because he said you could not step twice into the same river, for he himself thought you could not do so once.

Plutarch, de EI. 18, p. 392. Context:—It is not possible to step twice into the same river, according to Heraclitus, nor twice to find a perishable substance in a fixed state; but by the sharpness and quickness of change, it disperses and gathers again, or rather not again nor a second time, but at the same time it forms and is dissolved, it comes and goes (see frag. 40).

Idem, de Sera num. vind. 15, p. 559.

Simplicius in Aristot. Phys. f. 17 a.

XLII.—Arius Didymus from Eusebius, Praep. evang. xv. 20, p. 821. Context:—Concerning the soul, Cleanthes, quoting the doctrine of Zeno in comparison with the other physicists, said that Zeno affirmed the perceptive soul to be an exhalation, just as Heraclitus did. For, wishing to show that the vaporized souls are always of an intellectual nature, he compared them to a river, saying, "To those entering the same river, other and still other waters flow." And souls are exhalations from moisture. Zeno, therefore, like Heraclitus, called the soul an exhalation.

Compare Sextus Emp. Pyrrh. hyp. iii. 115.

XLIII.—Plutarch, de Iside 48, p. 370. Context:—For Heraclitus in plain terms calls war the father and king and lord of all (= frag. 44), and he says that Homer, when he prayed—"Discord be damned

that strife were destroyed from among gods and men." For there could be no harmony without sharps and flats, nor living beings without male and female, which are contraries.

XLIV.—War is the father and king of all, and has produced some as gods and some as men, and has made some slaves and some free.

XLV.—They do not understand how that which

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from gods and human race," forgot that he called down curses on the origin of all things, since they have their source in antipathy and war.

Chalcidius in Tim. 295.

Simplicius in Aristot. Categ. p. 104 Δ, ed. Basil.

Schol. Ven. (A) ad Il. xviii, 107.

Eustathius ad Il. xviii. 107, p. 1113, 56.

XLIV.—Hippolytus, Ref. haer. ix. 9. Context:—And that the father of all created things is created and uncreated, the made and the maker, we hear him (Heraclitus) saying, "War is the father and king of all," etc.

Plutarch, de Iside 48, p. 370. Context, see frag. 43.

Proclus in Tim. 54 A (comp. 24 B).

Compare Chrysippus from Philodem. π. εὐσεβείας, vii. p. 81, Gomperz.

Lucianus, Quomodo hist. conscrib. 2; Idem, Icaromen 8.

XLV.—Hippolytus, Ref. haer. ix. 9. Context, see frag. 1.

Plato, Symp. 187 A. Context:—And one who pays the least attention will also perceive that in music there is the same reconciliation of opposites; and I suppose that this must have been the meaning of Heraclitus, though his words are not accurate; for he says that the One is united by disunion, like the harmony of the bow and the lyre (Jowett's transl.).

Idem, Soph. 242 D. Context:—Then there are Ionian, and in more recent times Sicilian muses, who have conceived the thought that to unite the two principles is safer; and they say that being is one and many, which are held together by enmity and friendship, ever parting, ever meeting (idem).

Plutarch, de Anim. procreat. 27, p. 1026. Context:—And many call this (scil. necessity) destiny. Empedocles calls it love and hatred; Heraclitus, the harmony of oppositions as of the bow and of the lyre.

Compare Synesius, de Insomn. 135 A.

Parmenides v. 59, Stein.

separates unites with itself. It is a harmony of oppositions, as in the case of the bow and of the lyre.[17]

XLVI.—Aristotle, Eth. Nic. viii. 2, p. 1155 b 1. In reference to these things, some seek for deeper principles and more in accordance with nature. Euripides says, "The parched earth loves the rain, and the high heaven, with moisture laden, loves earthward to fall." And Heraclitus says, "The unlike is joined together, and from differences results the most beautiful harmony, and all things take place by strife."

XLVII.—The hidden harmony is better than the visible.[18 and 3]

XLVIII.—Let us not draw conclusions rashly about the greatest things.

XLIX.—Philosophers must be learned in very many things.

L.—The straight and crooked way of the wool-carders is one and the same.[19]

XLVI.—Compare Theophrastus, Metaph. 15.

Philo, Qu. in Gen. iii. 5, p. 178, Aucher.

Idem, de Agricult. 31, p. 321.

XLVII.—Hippolytus, Ref. haer. ix. 9–10. Context, see frag. 13.

Plutarch, de Anim. procreat. 27, p. 1026. Context:—Of the soul nothing is pure and unmixed nor remains apart from the rest, for, according to Heraclitus, "The hidden harmony is better than the visible," in which the blending deity has hidden and sunk variations and differences.

Compare Plotinus, Enn. i. 6, p. 53.

Proclus in Cratyl. p. 107, ed. Boissonad.

XLVIII.—Diogenes Laert. ix. 73. Context:—Moreover, Heraclitus says, "Let us not draw conclusions rashly about the greatest things." And Hippocrates delivered his opinions doubtfully and moderately.

XLIX.—Clement of Alex. Strom. v. 14, p. 733. Context:—Philosophers must be learned in very many things, according to Heraclitus. And, indeed, it is necessary that "he who wishes to be good shall often err."

L.—Hippolytus, Ref. haer. ix. 10. Context:—And both straight

LI.—Asses would choose stubble rather than gold.

LII.—Sea water is very pure and very foul, for, while to fishes it is drinkable and healthful, to men it is hurtful and unfit to drink.

LIII.—Columella, de Re Rustica viii. 4. Dry dust and ashes must be placed near the wall where the roof or eaves shelter the court, in order that there may be a place where the birds may sprinkle themselves, for with these things they improve their wings and feathers, if we may believe Heraclitus, the Ephesian, who says, "Hogs wash themselves in mud and doves in dust."

LIV.—They revel in dirt.

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and crooked, he (Heraclitus) says, are the same: "The way of the wool-carders is straight and crooked." The revolution of the instrument in a carder's shop (Gr. γναφείῳ Bernays, γραφείῳ vulg.) called a screw is straight and crooked, for it moves at the same time forward and in a circle. "It is one and the same," he says.

Compare Apuleius, de Mundo 21.

LI.—Aristotle, Eth. Nic. x. 5, p. 1176 a 6. Context:—The pleasures of a horse, a dog, or a man, are all different. As Heraclitus says, "Asses would choose stubble rather than gold," for to them there is more pleasure in fodder than in gold.

LII.—Hippolytus, Ref. haer. ix. 10. Context:—And foul and fresh, he (Heraclitus) says, are one and the same. And drinkable and undrinkable are one and the same. "Sea water," he says, "is very pure and very foul," etc.

Compare Sextus Empir. Pyrrh. hyp. i. 55.

LIII.—Compare Galenus, Protrept. 13, p. 5, ed. Bas.

LIV.—Athenaeus v. p. 178 F. Context:—For it would be unbecoming, says Aristotle, to go to a banquet covered with sweat and dust. For a well-bred man should not be squalid nor slovenly nor delight in dirt, as Heraclitus says.

Clement of Alex. Protrept. 10, p. 75.

Idem, Strom. i. 1, p. 317; ii. 15, p. 465.

Compare Sextus Empir. Pyrrh. hyp. i. 55.

Plotinus, Enn. i. 6, p. 55.

Vincentius Bellovac. Spec. mor. iii. 9, 3.

LV.—Every animal is driven by blows.[20]

LVI.—The harmony of the world is a harmony of oppositions, as in the case of the bow and of the lyre.[21]

LVII.—Good and evil are the same.

LVIII.—Hippolytus, Ref. haer. ix. 10. And good and evil (scil. are one). The physicians, therefore, says Heraclitus, cutting, cauterizing, and in every way torturing the sick, complain that the patients do not pay them fitting reward for thus effecting these benefits—†and sufferings.†

LV.—Aristotle, de Mundo 6, p. 401 a 8 (=Apuleius, de Mundo 36; Stobaeus, Ecl. i. 2, p. 86). Context:—Both wild and domestic animals, and those living upon land or in air or water, are born, live and die in conformity with the laws of God. "For every animal," as Heraclitus says, "is driven by blows" (πληγῇ Stobaeus cod. A, Bergkius et al.; vulg. τὴν γῆν νέμεται, every animal feeds upon the earth).

LVI.—Plutarch, de Tranquill. 15, p. 473. Context:—For the harmony of the world is a harmony of oppositions (Gr. παλίντονος ἁρμονίη, see Crit. Note 21), as in the case of the bow and of the lyre. And in human things there is nothing that is pure and unmixed. But just as in music, some notes are flat and some sharp, etc.

Idem, de Iside 45, p. 369. Context:—"For the harmony of the world is a harmony of opposition, as in the case of the bow and of the lyre," according to Heraclitus; and according to Euripides, neither good nor bad may be found apart, but are mingled together for the sake of greater beauty.

Porphyrius, de Antro. nymph. 29.

Simplicius in Phys. fol. 11 a.

Compare Philo, Qu. in Gen. iii. 5, p. 178, Aucher.

LVII.—Hippolytus, Ref. haer. ix. 10. Context, see frag. 58.

Simplicius in Phys. fol. 18 a. Context:—All things are with others identical, and the saying of Heraclitus is true that the good and the evil are the same.

Idem on Phys. fol. 11 a.

Aristotle, Top. viii. 5, p. 159 b 30.

Idem, Phys. i. 2, p. 185 b 20.

LVIII.—Compare Xenophon, Mem. i. 2, 54.

Plato, Gorg. 521 E; Polit. 293 B.

Simplicius in Epictetus 13, p. 83 D and 27, p. 178 A, ed. Heins.

LIX.—Unite whole and part, agreement and disagreement, accordant and discordant; from all comes one, and from one all.

LX.—They would not know the name of justice, were it not for these things.[22]

LXI.—Schol. B. in Iliad iv. 4, p. 120 Bekk. They say that it is unfitting that the sight of wars should please the gods. But it is not so. For noble works delight them, and while wars and battles seem to us terrible, to God they do not seem so. For God in his dispensation of all events, perfects them into a harmony of the whole, just as, indeed, Heraclitus says that to God all things are beautiful and good and right, though men suppose that some are right and others wrong.

LXII.—We must know that war is universal and strife right, and that by strife all things arise and †are used.†[23]

LIX.—Aristotle, de Mundo 5, p. 396 b 12 (= Apuleius, de Mundo 20; Stobaeus, Ecl. i. 34, p. 690). Context:—And again art, imitator of nature, appears to do the same. For in painting, it is by the mixing of colors, as white and black or yellow and red, that representations are made corresponding with the natural types. In music also, from the union of sharps and flats comes a final harmony, and in grammar, the whole art depends on the blending of mutes and vocables. And it was the same thing which the obscure Heraclitus meant when he said, "Unite whole and part," etc.

Compare Apuleius, de Mundo 21.

Hippocrates π. τροφῆς 40; π. διαίτης i.

LX.—Clement of Alex. Strom. iv. 3, p. 568. Context:—For the Scripture says, the law is not made for the just man. And Heraclitus well says, "They would not know the name of justice, were it not for these things."

Compare pseudo-Heraclitus, Epist. vii.

LXI.—Compare Hippocrates, περὶ διαίτης i. 11.

LXII.—Origen, cont. Celsus vi. 42, p. 312 (Celsus speaking). Context:—There was an obscure saying of the ancients that war was divine, Heraclitus writing thus, "We must know that war," etc.

Compare Plutarch, de Sol. animal. 7, p. 964.

Diogenes Laert. ix. 8.

LXIII.—For it is wholly destined———.

LXIV.—Death is what we see waking. What we see in sleep is a dream.[24]

LXV.—There is only one supreme Wisdom. It wills and wills not to be called by the name of Zeus.[25]

LXVI.—The name of the bow is life, but its work is death.

LXVII.—Immortals are mortal, mortals immortal, living in their death and dying in their life.

LXIII.—Stobaeus Ecl. i. 5, p. 178. Context:—Heraclitus declares that destiny is the all-pervading law. And this is the etherial body, the seed of the origin of all things, and the measure of the appointed course. All things are by fate, and this is the same as necessity. Thus he writes, "For it is wholly destined———" (The rest is wanting).

LXIV.—Clement of Alex. Strom. iii. 3, p. 520. Context:—And does not Heraclitus call death birth, similarly with Pythagoras and with Socrates in the Gorgias, when he says, "Death is what we see waking. What we see in sleep is a dream"?

Compare idem v. 14, p. 712. Philo, de Ioseph. 22, p. 59.

LXV.—Clement of Alex. Strom. v. 14, p. 718 (Euseb. P. E. xiii. 13, p. 681). Context:—I know that Plato also bears witness to Heraclitus' writing, "There is only one supreme Wisdom. It wills and wills not to be called by the name of Zeus." And again, "Law is to obey the will of one" (= frag. 110).

LXVI.—Schol. in Iliad i. 49, fr. Cramer, A. P. iii. p. 122. Context:—For it seems that by the ancients the bow and life were synonymously called *βιός*. So Heraclitus, the obscure, said, "The name of the bow is life, but its work is death."

Etym. magn. under word *βιός*.

Tzetze's Exeg. in Iliad, p. 101 Herm.

Eustathius in Iliad i. 49, p. 41.

Compare Hippocrates, *π. τροφῆς* 21.

LXVII.—Hippolytus, Ref. haer. ix. 10. Context:—And confessedly he (Heraclitus) asserts that the immortal is mortal and the mortal immortal, in such words as these, "Immortals are mortal," etc.

Numenius from Porphyr. de Antro nymph. 10. Context, see frag. 72.

LXVIII.—To souls it is death to become water, and to water it is death to become earth, but from earth comes water, and from water, soul.

LXIX.—The way upward and downward are one and the same.

Philo, Leg. alleg. i. 33, p. 65.
Idem, Qu. in Gen. iv. 152, p. 360 Aucher.
Maximus Tyr. x. 4, p. 107. Idem, xli. 4, p. 489.
Clement of Alex. Paed. iii. 1, p. 251.
Hierocles in Aur. carm. 24.
Heraclitus, Alleg. Hom. 24, p. 51 Mehler.
Compare Lucianus, Vit. auct. 14.
Dio Cassius frr. i—xxxv. c. 30, t. i. p. 40 Dind.
Hermes from Stob. Ecl. i. 39, p. 768. Idem, Poemand. 12, p. 100.

LXVIII.—Clement of Alex. Strom. vi. 2, p. 746. Context:—(On plagiarisms) And Orpheus having written, "Water is death to the soul and soul the change from water; from water is earth and from earth again water, and from this the soul welling up through the whole ether"; Heraclitus, combining these expressions, writes as follows: "To souls it is death," etc.

Hippolytus, Ref. haer. v. 16. Context:—And not only do the poets say this, but already also the wisest of the Greeks, of whom Heraclitus was one, who said, "For the soul it is death to become water."

Philo, de Incorr. mundi 21, p. 509. Proclus in Tim. p. 36 C.
Aristides, Quintil. ii. p. 106, Meib.
Iulianus, Or. v. p. 165 D.
Olympiodorus in Plato, Gorg. p. 357 Iahn; Idem, p. 542.

LXIX.—Hippolytus, Ref. haer. ix. 10. Context:—Up and down he (Heraclitus) says are one and the same. "The way upward and downward are one and the same."

Diogenes Laert. ix. 8. Context:—Heraclitus says that change is the road leading upward and downward, and that the whole world exists according to it.

Cleomedes, *π. μετεώρων* i. p. 75, Bak.
Maximus Tyr. xli. 4, p. 489.
Plotinus, Enn. iv. 8, p. 468.
Tertullian, adv. Marc. ii. 28.
Iamblichus from Stob. Ecl. i. 41.
Compare Hippocrates, *π. τροφῆς* 45.
M. Antoninus vi. 17.

LXX.—The beginning and end are common.

LXXI.—The limits of the soul you would not find out, though you should traverse every way.

LXXII.—To souls it is joy to become wet.[26]

LXXIII.—A man when he is drunken is led by a beardless youth, stumbling, ignorant where he is going, having a wet soul.

LXXIV.—The dry soul is the wisest and best.[27]

Philo, de Incorr. mundi 21, p. 508.

Idem, de Somn. i. 24, p. 644.

Idem, de vit. Moys. i. 6, p. 85.

Musonius from Stob. Flo. 108, 60.

LXX.—Porphyry from Schol. B. Iliad xiv. 200, p. 392, Bekk. Context:—For the beginning and end on the periphery of the circle are common, according to Heraclitus.

Compare Hippocrates, *π. τόπων τῶν κατ' ἄνθρωπον*, 1.

Idem, *π. διαίτης* i. 19; *π. τροφῆς*, 9.

Philo, Leg. alleg. i. 3, p. 44. Plutarch, de EI. 8, p. 388.

LXXI.—Diogenes Laert. ix. 7. Context:—And he (Heraclitus) also says, "The limits of the soul you would not find out though you traverse every way," so deep lies its principle (*οὕτω βαθὺν λόγον ἔχει*).

Tertullian, de Anima 2.

Compare Hippolytus, Ref. haer. v. 7.

Sextus, Enchir. 386.

LXXII.—Numenius from Porphyry, de Antro nymph. 10. Context:—Wherefore Heraclitus says: To souls it is joy, not death, to become wet. And elsewhere he says: We live in their death and they live in our death (frag. 67).

LXXIII.—Stobaeus Floril. v. 120.

Compare M. Antoninus iv. 46. Context, see frag. 5.

LXXIV.—Plutarch, Romulus 28. Context:—For the dry soul is the wisest and best, according to Heraclitus. It flashes through the body as the lightning through the cloud (=fr. 63, Schleiermacher).

Aristides, Quintil. ii. p. 106.

Porphyry, de Antro nymph. 11.

Synesius, de Insomn. p. 140 A Petav.

Stobaeus Floril. v. 120.

Glycas, Ann. i. p. 74 B (compare 116 A).

Compare Clement of Alex. Paedag. ii. 2, p. 184.

Eustathius in Iliad xxiii. 261, p. 1299, 17 ed. Rom.

LXXV.—†The dry beam is the wisest and best soul.†

LXXVI.—†Where the land is dry, the soul is wisest and best.†[27]

LXXVII.—Man, as a light at night, is lighted and extinguished.[28]

LXXVIII.—Plutarch, Consol. ad Apoll. 10, p. 106. For when is death not present with us? As indeed Heraclitus says: Living and dead, awake and asleep, young and old, are the same. For these several states are transmutations of each other.

LXXIX.—Time is a child playing at draughts, a child's kingdom.

LXXV.—Philo from Euseb. P. E. viii. 14, p. 399.

Musonius from Stob. Floril. xvii. 43.

Plutarch, de Esu. carn. i. 6, p. 995.

Idem, de Def. orac. 41, p. 432.

Galenus, π. τῶν τῆς ψυχῆς ἠθῶν 5, t. i. p. 346, ed. Bas.

Hermeias in Plat. Phaedr. p. 73, Ast.

Compare Porphyry, ἀφορμ. πρὸς τὰ νοητά 33, p. 78 Holst.; Ficinus, de Immort. anim. viii. 13.

LXXVI.—Philo from Euseb. P. E. vi. 14, p. 399.

Idem, de Provid. ii. 109, p. 117, Aucher.

LXXVII.—Clement of Alex. Strom. iv. 22, p. 628. Context:—Whatever they say of sleep, the same must be understood of death, for it is plain that each of them is a departure from life, the one less, the other more. Which is also to be received from Heraclitus: Man is kindled as a light at night; in like manner, dying, he is extinguished. And living, he borders upon death while asleep, and, extinguishing sight, he borders upon sleep when awake.

Compare Sextus Empir. adv. Math. vii. 130.

Seneca, Epist. 54.

LXXVIII.—Compare Plutarch, de EI. 18, p. 392.

Clement of Alex. Strom. iv. 22, p. 628. Context, see frag. 77.

Sextus Empir. Pyrrh. hyp. iii. 230.

Tzetze's Chil. ii. 722.

LXXIX.—Hippolytus, Ref. haer. ix. 9.

Proclus in Tim. 101 F. Context:—And some, as for example Heraclitus, say that the creator in creating the world is at play.

Lucianus, Vit. auct. 14. Context:—And what is time? A child at play, now arranging his pebbles, now scattering them.

LXXX.—I have inquired of myself.[29]

LXXXI.—Into the same river we both step and do not step. We both are and are not.

LXXXII.—It is weariness upon the same things to labor and by them to be controlled.[30]

Clement of Alex. Paedag. i. 5, p. 111.

Iamblichus from Stob. Ecl. ii. 1, p. 12.

Compare Plato, Legg. x. 903 D. Philo, de vit. Moys. i. 6, p. 85.

Plutarch, de EI. 21, p. 393.

Gregory Naz. Carm. ii. 85, p. 978 ed. Bened.

LXXX.—Diogenes Laert. ix. 5. Context:—And he (Heraclitus) was a pupil of no one, but he said he inquired of himself and learned everything by himself.

Plutarch, adv. Colot. 20, p. 1118. Context:—And Heraclitus, as though he had been engaged in some great and solemn task, said, "I have been seeking myself." And of the sentences at Delphi, he thought the "Know thyself" to be the most divine.

Dio Chrysost. Or. 55, p. 282, Reiske.

Plotinus, Enn. iv. 8, p. 468.

Tatianus, Or. ad Graec. 3.

Iulianus, Or. vi. p. 185 A.

Proclus in Tim. 106 E.

Suidas, under word Ποστοῦμος.

Compare Philo, de Ioseph. 22, p. 59.

Clement of Alex. Strom. ii. 1, p. 429.

Plotinus, Enn. v. 9, p. 559.

LXXXI.—Heraclitus, Alleg. Hom. 24.

Seneca, Epist. 58. Context:—And I, while I say these things are changed, am myself changed. This is what Heraclitus means when he says, into the same river we descend twice and do not descend, for the name of the river remains the same, but the water has flowed on. This in the case of the river is more evident than in case of man, but none the less does the swift course carry us on.

Compare Epicharmus, fr. B 40, Lorenz.

Parmenides v. 58, Stein.

LXXXII.—Plotinus, Enn. iv. 8, p. 468.

Iamblichus from Stob. Ecl. i. 41, p. 906. Context:—For Heraclitus assumed necessary changes from opposites, and supposed that souls traversed the way upward and downward, and that to continue in the same condition is weariness, but that change brings rest (= fr. 83).

LXXXIII.—In change is rest.

LXXXIV.—A mixture separates when not kept in motion.

LXXXV.—Corpses are more worthless than excrement.

LXXXVI.—Being born, they will only to live and die, or rather to find rest, and they leave children who likewise are to die.

LXXXVII.—Plutarch, de Orac. def. 11, p. 415.

Aeneas, Gaz. Theophrast. p. 9.
Compare Hippocrates, π. διαίτης i. 15.
Philo, de Cherub. 26, p. 155.

LXXXIII.—Plotinus, Enn. iv. 8, p. 468.
Idem, iv. 8, p. 473.
Iamblichus from Stob. Ecl. i. 41, p. 906. Context, see frag. 82.
Idem, p. 894.
Aeneas, Gaz. Theophrast. p. 9, Barth.
Idem, p. 11.

LXXXIV.—Theophrastus, de Vertigine 9, p. 138 Wimmer.
Alexander Aprod. Probl. p. 11, Usener. Context:—A mixture (ὁ κυκεών), as Heraclitus says, separates unless some one stirs it.
Compare Lucian, Vit. auct. 14.
M. Antoninus iv. 27.

LXXXV.—Strabo xvi. 26, p. 784. Context:—They consider dead bodies equal to excrement, just as Heraclitus says, "Corpses are more worthless," etc.
Plutarch, Qu. conviv. iv. 4, p. 669.
Pollux, Onom. v. 163.
Origen, c. Cels. v. 14, p. 247.
Julian, Or. vii. p. 226 C.
Compare Philo, de Profug. ii. p. 555.
Plotinus, Enn. v. 1, p. 483.
Schol. V. ad Iliad xxiv. 54, p. 630, Bekk.
Epictetus, Diss. ii. 4, 5.

LXXXVI.—Clement of Alex. Strom. iii. 3, p. 516. Context:—Heraclitus appears to be speaking evil of birth when he says, "Being born, they wish only to live," etc.

LXXXVII.—The reference is to the following passage from Hesiod:

Those who adopt the reading *ἡβῶντος* (*i. e.* at man's estate, see Hesiod, fr. 163, ed. Goettling) reckon a generation at thirty years, according to Heraclitus, in which time a father may have a son who is himself at the age of puberty.

LXXXVIII.—Io. Lydus de Mensibus iii. 10, p. 37, ed. Bonn. Thirty is the most natural number, for it bears the same relation to tens as three to units. Then again it is the monthly cycle, and is composed of the four numbers 1, 4, 9, 16, which are the squares of the units in order. Not without reason, therefore, does Heraclitus call the month a generation.

LXXXIX.—In thirty years a man may become a grandfather.

XC.—M. Antoninus vi. 42. We all work together to one end, some consciously and with purpose, others unconsciously. Just as indeed Heraclitus, I think, says that the sleeping are co-workers and fabricators of the things that happen in the world.[31]

XCI.—The Law of Understanding is common to all. Those who speak with intelligence must hold fast to that which is common to all, even more strongly than

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ἐννέα τοι ζώει γενεὰς λακέρυζα κορώνη
ἀνδρῶν ἡβώντων· ἔλαφος δέ τε τετρακόρων ος
τρεῖς δ' ἐλάφους ὁ κόραξ γηράσκεται. ἀυτὰρ ὁ φοίνιξ
ἐννέα τοὺς κόρακας· δέκα δ' ἡμεῖς τοὺς φοίνικας
νύμφαι ἐυπλόκαμοι, κοῦραι Διὸς ἀιγιόχοιο.

Censorinus, de D. N. 17.
Compare Plutarch, Plac. Philos. v. 24, p. 909.
LXXXVIII.—Crameri A. P. i. p. 324.
Compare Philo, Qu. on Gen. ii. 5, p. 82 Aucher.
Plutarch, de Orac. def. 12, p. 416.
LXXXIX.—Philo, Qu. in Gen. ii. 5, p. 82 Aucher.
XCI.—Stobaeus Floril. iii. 84.
Compare Cleanthes H., Iov. 24.
Hippocrates, *π. τροφῆς* 15. Plutarch, de Iside 45, p. 369.
Plotinus, Enn. vi. 5, p. 668. Empedocles v. 231 Stein.

a city holds fast to its law. For all human laws are dependent upon one divine Law, for this rules as far as it wills, and suffices for all, and overabounds.

XCII.—Although the Law of Reason is common, the majority of people live as though they had an understanding of their own.

XCIII.—They are at variance with that with which they are in most continual association.

XCIV.—We ought not to act and speak as though we were asleep.

XCV.—Plutarch, de Superst. 3, p. 166. Heraclitus says: To those who are awake, there is one world in common, but of those who are asleep, each is withdrawn to a private world of his own.

XCVI.—For human nature does not possess understanding, but the divine does.

XCII.—Sextus Emp. adv. Math. vii. 133. Context:—For having thus statedly shown that we do and think everything by participation in the divine reason, he (Heraclitus), after some previous exposition, adds: It is necessary, therefore, to follow the common (for by ξυνὸς he means ὁ κοινός, the common). For although the law of reason is common, the majority of people live as though they had an understanding of their own. But this is nothing else than an explanation of the mode of the universal disposition. As far, therefore, as we participate in the memory of this, we are true; but in as far as we act individually, we are false.

XCIII.—M. Antoninus iv. 46. Context, see frag. 5.

XCIV.—M. Antoninus iv. 46. Context, see frag. 5.

XCV.—Compare pseudo-Pythagoras from Hippolytus, Ref. haer. vi. 26.

Iamblichus, Protrept. 21, p. 132, Arcer.

XCVI.—Origen, c. Cels. vi. 12, p. 291. Context:—Nevertheless he (Celsus) wanted to show that this was a fabrication of ours and taken from the Greek philosophers, who say that human wisdom is of one kind, and divine wisdom of another. And he brings forward some phrases of Heraclitus, one where he says, "For human nature does not possess understanding, but the divine does." And another, "The thoughtless man understands the voice of the Deity as little as the child understands the man" (= frag. 97).

XCVII.—The thoughtless man understands the voice of the Deity as little as the child understands the man.[32]

XCVIII.—Plato, Hipp. mai. 289 B. And does not Heraclitus, whom you bring forward, say the same, that the wisest of men compared with God appears an ape in wisdom and in beauty and in all other things?

XCIX.—Plato, Hipp. mai. 289 A. You are ignorant, my man, that there is a good saying of Heraclitus, to the effect that the most beautiful of apes is ugly when compared with another kind, and the most beautiful of earthen pots is ugly when compared with maiden-kind, as says Hippias the wise.

C.—The people must fight for their law as for their walls.

CI.—Greater fates gain greater rewards.

CII.—Gods and men honor those slain in war.

CIII.—Presumption must be quenched even more than a fire.[33]

XCVII.—Origen, c. Cels. vi. 12, p. 291. Context, see frag. 96.
Compare M. Antoninus iv. 46. Context, see frag. 5.

XCVIII.—Compare M. Antoninus iv. 16.

XCIX.—Compare Plotinus, Enn. vi. 3, p. 626.
Aristotle, Top. iii. 2, p. 117 b 17.

C.—Diogenes Laert. ix. 2. Context:—And he (Heraclitus) used to say, "It is more necessary to quench insolence than a fire" (= frag. 103). And, "The people must fight for their law as for their walls."

CI.—Clement of Alex. Strom. iv. 7, p. 586. Context:—Again Aeschylus, grasping this thought, says, "To him who toils, glory from the gods is due as product of his toil." "For greater fates gain greater rewards," according to Heraclitus.
Theodoretus, Therap. viii. p. 117, 33.
Compare Hippolytus, Ref. haer. v. 8.

CII.—Clement of Alex. Strom. iv. 4, p. 571. Context:—Heraclitus said, "Gods and men honor those slain in war."
Theodoretus, Therap. viii. p. 117, 33.

CIII.—Diogenes Laert. ix. 2. Context, see frag. 100.

CIV.—For men to have whatever they wish, would not be well. Sickness makes health pleasant and good; hunger, satiety; weariness, rest.

CV.—It is hard to contend against passion, for whatever it craves it buys with its life.

CVI.—† It pertains to all men to know themselves and to learn self-control.†

CVII.—† Self-control is the highest virtue, and wisdom is to speak truth and consciously to act according to nature.†[34]

CVIII.—It is better to conceal ignorance, but it is hard to do so in relaxation and over wine.

CIV.—Stobaeus Floril. iii. 83, 4.

Compare Clement of Alex. Strom. ii. 21, p. 497.

Theodoretus, Therap. xi. p. 152, 25. Context:—Heraclitus the Ephesian changed the name but retained the idea, for in the place of pleasure he put contentment.

CV.—Iamblichus, Protrept. p. 140, Arcer. Context:—Heraclitus is a witness to these statements, for he says, "It is hard to contend against passion," etc.

Aristotle, Eth. Nic. ii. 2, p. 1105 a 8.
Idem, Eth. Eud. ii. 7, p. 1223 b 22.
Idem, Pol. v. 11, p. 1315 a 29.
Plutarch, de Cohib. ira 9, p. 457.
Idem, Erot. 11, p. 755.
Compare Plutarch, Coriol. 22.
Pseudo-Democritus fr. mor. 77, Mullach.
Longinus, de Subl. 44.

CVI.—Stobaeus Floril. v. 119.

CVII.—Stobaeus Floril. iii. 84.

CVIII.—Plutarch, Qu. Conviv. iii. proem., p. 644. Context:—Simonides, the poet, seeing a guest sitting silent at a feast and conversing with no one, said, "Sir, if you are foolish you are doing wisely, but if wise, foolishly," for, as Heraclitus says, "It is better to conceal ignorance, but it is hard," etc.

Idem, de Audiendo 12, p. 43.
Idem, Virt. doc. posse 2, p. 439.
Idem, from Stob. Floril. xviii. 32.

CIX.—† It is better to conceal ignorance than to expose it.†

CX.—It is law, also, to obey the will of one.[35]

CXI.—For what sense or understanding have they? They follow minstrels and take the multitude for a teacher, not knowing that many are bad and few good. For the best men choose one thing above all—immortal glory among mortals; but the masses stuff themselves like cattle.

CXII.—In Priene there lived Bias, son of Teutamus, whose word was worth more than that of others.

CXIII.—To me, one is ten thousand if he be the best.

CXIV.—The Ephesians deserve, man for man, to be hung, and the youth to leave the city, inasmuch as they have banished Hermodorus, the worthiest man among them, saying: "Let no one of us excel, and if

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CIX.—Stobaeus Floril. iii. 82.

CX.—Clement of Alex. Strom. v. 14, p. 718 (Euseb. P. E. xiii. 13, p. 681). Context, see frag. 65.

CXI.—The passage is restored as above by Bernays (Heraclitea i. p. 34), and Bywater (p. 43), from the following sources:

Clement of Alex. Strom. v. 9, p. 682.

Proclus in Alcib. p. 255 Creuzer, = 525 ed. Cous. ii.

Clement of Alex. Strom. iv. 7, p. 586.

CXII.—Diogenes Laert. i. 88. Context:—And the fault-finding Heraclitus has especially praised him (Bias), writing, "In Priene there lived Bias, son of Teutamus, whose word was worth more than that of others," and the Prienians dedicated to him a grove called the Teutamion. He used to say, "Most men are bad."

CXIII.—Theodorus Prodromus in Lazerii Miscell. i. p. 20.

Idem, Tetrastich. in Basil. I (fol. κ 2 vers. ed. Bas.).

Galenus, περὶ διαγνώσεως σφυγμῶν i. 1; t. 3, p. 53 ed. Bas.

Symmachus, Epist. ix. 115.

Compare Epigramm. from Diogenes Laert. ix. 16.

Cicero, ad. Att. xvi. 11.

Seneca, Epist. 7.

CXIV.—Strabo xiv. 25, p. 642. Context:—Among distinguished men of the ancients who lived here (Ephesus) were Heraclitus,

there be any such, let him go elsewhere and among other people."

CXV.—Dogs, also, bark at what they do not know.

CXVI.—By its incredibility, it escapes their knowledge.[36]

CXVII.—A stupid man loves to be puzzled by every discourse.

CXVIII.—The most approved of those who are of repute knows how to cheat. Nevertheless, justice will catch the makers and witnesses of lies.[37]

CXIX.—Diogenes Laert. ix. 1. And he (Heraclitus)

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called the obscure, and Hermodorus, of whom Heraclitus himself said, "The Ephesians deserve," etc.

Cicero, Tusc. v. 105.

Musonius from Stob. Floril. xl. 9.

Diogenes Laert. ix. 2.

Iamblichus, de Vit. Pyth. 30, p. 154 Arcer.

Compare Lucian, Vit. auct. 14.

Pseudo-Diogenes, Epist. 28, 6.

CXV.—Plutarch, An seni sit ger. resp. vii. p. 787. Context:—And envy, which is the greatest evil public men have to contend with, is least directed against old men. "For dogs, indeed, bark at what they do not know," according to Heraclitus.

CXVI.—Plutarch, Coriol. 38. Context:—But knowledge of divine things escapes them, for the most part, because of its incredibility, according to Heraclitus.

Clement of Alex. Strom. v. 13, p. 699. Context, see Crit. Note 36.

CXVII.—Plutarch, de Audiendo 7, p. 41. Context:—They reproach Heraclitus for saying, "A stupid man loves," etc.

Compare idem, de Aud. poet. 9, p. 28.

CXVIII.—Clement of Alex. Strom. v. 1, p. 649. Context:—"The most approved of those who are of repute knows how to be on his guard (*φυλάσσειν*, see Crit. Note 37). Nevertheless, justice will catch the makers and witnesses of lies," says the Ephesian. For this man who was acquainted with the barbarian philosophy, knew of the purification by fire of those who had lived evil lives, which afterwards the Stoics called the conflagration (*ἐκπύρωσιν*).

CXIX.—Schleiermacher compares Schol. Ven. ad Iliad xviii. 251 and Eustathius, p. 1142, 5 ed. Rom., which, however, Bywater does not regard as referring to Heraclitus of Ephesus.

used to say that Homer deserved to be driven out of the lists and flogged, and Archilochus likewise.

CXX.—One day is like all.

CXXI.—A man's character is his daemon.[88]

CXXII.—There awaits men after death what they neither hope nor think.

CXXIII.—And those that are there shall arise and become guardians of the living and the dead.[89]

CXXIV.—Night-roamers, Magians, bacchanals, revelers in wine, the initiated.

CXX.—Seneca, Epist. 12. Context:—Heraclitus, who got a nickname for the obscurity of his writing, said, "One day is like all." His meaning is variously understood. If he meant all days were equal in number of hours, he spoke truly. But others say one day is equal to all in character, for in the longest space of time you would find nothing that is not in one day, both light and night and alternate revolutions of the earth.

Plutarch, Camill. 19. Context:—Concerning unlucky days, whether we should suppose there are such, and whether Heraclitus did right in reproaching Hesiod who distinguished good and bad days, as being ignorant that the nature of every day is one, has been examined in another place.

CXXI.—Plutarch, Qu. Platon. i. 2, p. 999. Context:—Did he, therefore (viz. Socrates) call his own nature, which was very critical and productive, God? Just as Menander says, "Our mind is God." And Heraclitus, "A man's character is his dæmon."

Alexander Aphrod. de Fato 6, p. 16, Orell.

Stobaeus Floril. civ. 23. Comp. pseudo-Heraclitus, Epist. 9.

CXXII.—Clement of Alex. Strom. iv. 22, p. 630. Context:—With him (Socrates), Heraclitus seems to agree when he says in his discourse on men, "There awaits men," etc.

Idem, Protrept. 2, p. 18. Theodoretus, Therap. viii. p. 118, 1.

Themistius (Plutarch) from Stob. Floril. cxx. 28.

CXXIII.—Hippolytus, Ref. haer. ix. 10. Context:—And he (Heraclitus) says also that there is a resurrection of this visible flesh of ours, and he knows that God is the cause of this resurrection, since he says, "And those that are there shall arise," etc.

Compare Clement of Alex. Strom. v. 1, p. 649.

CXXIV.—Clement of Alex. Protrept. 2, p. 18. Context:—Rites worthy of the night and of fire, and of the great-hearted, or rather

CXXV.—For the things which are considered mysteries among men, they celebrate sacrilegiously.

CXXVI.—And to these images they pray, as if one should prattle with the houses knowing nothing of gods or heroes, who they are.

CXXVII.—For were it not Dionysus to whom they institute a procession and sing songs in honor of the pudenda, it would be the most shameful action. But Dionysus, in whose honor they rave in bacchic frenzy, and Hades are the same.[40]

CXXVIII.—Iamblichus, de Mysteriis v. 15. I distinguish two kinds of sacrifices. First, those of men wholly purified, such as would rarely happen in the case of a single individual, as Heraclitus says, or of a

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of the idle-minded people of the Erechthidae, or even of the other Greeks, for whom there awaits after death what they do not hope (see frag. 122). Against whom, indeed, does Heraclitus of Ephesus prophesy? Against night-roamers, Magians, bacchanals, revelers in wine, the initiated. These he threatens with things after death and prophesies fire for them, for they celebrate sacrilegiously the things which are considered mysteries among men (= frag. 125).

CXXV.—Clement of Alex. Protrept. 2, p. 19. Context, see frag. 124.

Compare Arnobius, adv. Nat. v. 29.

CXXVI.—Origen, c. Cels. vii. 62, p. 384.

Idem i. 5, p. 6.

Clement of Alex. Protrept. 4, p. 44. Context:—But if you will not listen to the prophetess, hear your own philosopher, Heraclitus, the Ephesian, imputing unconsciousness to images, "And to these images," etc.

CXXVII.—Clement of Alex. Protrept. 2, p. 30. Context:—In mystic celebration of this incident, phalloi are carried through the cities in honor of Dionysus. "For were it not Dionysus to whom they institute a procession and sing songs in honor of the pudenda, it would be the most shamful action," says Heraclitus. "But Hades and Dionysus are the same, to whom they rave in bacchic frenzy," not for the intoxication of the body, as I think, so much as for the shameful ceremonial of lasciviousness.

Plutarch, de Iside 28, p. 362.

certain very few men. Second, material and corporeal sacrifices and those arising from change, such as are fit for those still fettered by the body.

CXXIX.—Atonements.[41]

CXXX.—When defiled, they purify themselves with blood, just as if any one who had fallen into the mud should wash himself with mud!

CXXIX.—Iamblichus, de Mys. i. 11. Context:—Therefore Heraclitus rightly called them (scil. what are offered to the gods) "atonements," since they are to make amends for evils and render the souls free from the dangers in generation.

Compare Hom. Od. xxii. 481. See Crit. Note 41.

CXXX.—Elias Cretensis in Greg. Naz. l. l. (cod. Vat. Pii. 11, 6, fol. 90 r). Context:—And Heraclitus, making sport of these people, says, "When defiled, they purify themselves with blood, just as if any one who had fallen into the mud should wash himself with mud!" For to suppose that with the bodies and blood of the unreasoning animals which they offer to their gods they can cleanse the impurities of their own bodies, which are stained with vile contaminations, is like trying to wash off mud from their bodies by means of mud.

Gregory Naz. Or. xxv. (xxiii.) 15, p. 466 ed. Par. 1778.

Apollonius, Epist. 27.

Compare Plotinus, Enn. i. 6, p. 54.

CRITICAL NOTES.

Fragment 1.

Note 1.—Instead of λόγου, MS has δόγματος, corrected by Bernays, followed by all critics except Bergk.

Fragment 2.

Note 2.—The λόγος of Heraclitus stood for the element of order or law in the ever-shifting world. Our word Reason may express the same idea more in accord with the thought of that time (see Introduction, p. 618 ff.). Zeller and Pfleiderer understand by it, Reason ruling or immanent in the world; Heinze, the objective (unconscious) law of Reason; Bernays, conscious Intelligence; Teichmüller, self-conscious Reason; Schuster, on the other hand, regards it as the "revelation offered us by the audible Speech of Nature." In the present passage, Zeller is inclined to understand by τοῦ λόγου τοῦδε, primarily the discourse of the author, but containing also the idea of the content of the discourse, *i. e.* the theory of the world laid down in his book (Vol. 1, p. 572, 2). For fuller account of the λόγος, compare Introduction, pp. 567, 571, 587, 604, 618, 620.

Fragment 13.

Note 3.—Bywater reads, Ὅσων ὄψις ἀκοὴ μάθησις, ταῦτα ἐγὼ προτιμέω; Compare Introduction, p. 578 f.

Fragment 15.

Note 4.—Compare Introduction, p. 607. Bernays (Rhein. Mus. ix. 261 f.) offers the explanation that the eyes are more exact witnesses than the ears, because by the eyes we have the only pure cognition of fire, in the perception of which is the only true knowledge.

Fragment 18.

Note 5.—See Introduction, p. 595 ff.

Fragment 19.

Note 6.—Common reading has ἓν τὸ σοφόν ἐπίστασθαι γνώμην ἥτε οἱ ἐγκυβερνήσει πάντα διὰ πάντων. Schleiermacher, γνώμην οἴη κυβερνήσει. Bernays, ἥτε οἰακίζει. Schuster, ἥτε οἴη τε κυβερνήσει.

Fragment 20.

Note 7.—The sense of ἁπάντων is uncertain. In the citations from Plutarch and Simplicius, the word is omitted; they read

κόσμον τόνδε. Zeller, whose interpretation of the word we have followed, takes it as masculine, referring to the gods and men, the meaning then being, that since gods and men are included in the world as part of it, they could not have created it. Schuster, on the other hand, renders it as follows: "Die Welt, die alles in sich befasst [die neben sich weder für andre Welten noch für einen Schöpfer Raum hat]," etc.

FRAGMENT 21.

Note 8.—*Πρηστήρ* is rendered by Schuster "fiery wind" such as forms the stars. Zeller (Vol. 1, p. 588, 1) believes it has essentially the same signification as *κεραυνός* in frag. 28, both words being other terms for the world-ruling fire or formative principle of the world.

FRAGMENT 23.

Note 9.—Eusebius omits *γῆ*, and is followed by Lassalle and Heinze. The former (Vol. 2, p. 63) translates, "Das Meer wird ausgegossen und gemessen nach demselben Logos, welcher zuerst war, ehe es (selbst) noch war," and finds here a confirmation of his interpretation of the Logos as the eternal preëxisting law of the identity of being and not-being. Heinze understands it as follows: "Das Meer verwandelt sich in denselben Logos, also in dasselbe Feuer, von welcher Beschaffenheit es vorher war, ehe es selbst entstand." Schuster reads *γῆν* and translates, "Das Meer ergiesst sich und nimmt sein Maass ein im selben Umfang, wie damals als noch keine Erde war" (p. 129). Zeller reads *γῆ* and understands the passage to refer to the return of the earth into the sea from which it sprang. By *λόγος* here he understands "proportion of magnitude" or "size," so that *ἐς τὸν αὐτὸν λόγον* means that the sea returns "to the same size" as before it became earth (Vol. 1, p. 628, 3).

FRAGMENT 24.

Note 10.—See Introduction, pp. 574, 581, 627.

FRAGMENT 25.

Note 11.—This fragment is not accepted by Zeller, who holds that air was not recognized by Heraclitus as one of the elements, but that he accepted only the three, fire, water, and earth. Air was added, Zeller thinks, by later writers, who confused it with the "soul" of Heraclitus (Vol. 1, p. 615). Schuster, who thinks Heraclitus did not teach a specific number of elements after the manner of Empedocles, regards the passage as trustworthy (p. 157 ff.). Teichmüller gives to air an important place in the system of Heraclitus, distinguishing the upper pure air, which is not different from fire, and the impure lower air (Vol. 1, p. 62).

Fragment 27.

Note 12.—Schleiermacher, followed by Mullach, reads *τινα* for *τις*, so that the sense becomes, "How can that which never sets escape any one?" This is unnecessary and violates the context in Clement. That which never sets is the eternal Order or Law, conceived here as Destiny or Justice. According to Zeller (Vol. 1, p. 590), that which never sets is fire. According to Schuster (p. 184), it is Relation or Law, and the *τις* refers to Helios, which, though itself the centre of power and intelligence, is yet subject to law. Teichmüller (Vol. 1, p. 184) understands it to refer to Justice or Destiny, which never sets like the sun, and which none can escape.

Fragment 35.

Note 13.—Πλείστων may be taken as neuter: "Hesiod was a teacher of the greatest number of things." On the unity of day and night, compare Introduction, p. 591 f.

Fragment 36.

Note 14.—The original text, which reads *ὁκόταν συμμιγῇ θυώμασι*, has been variously corrected. As the subject of *συμμιγῇ*, Schuster inserts *οἶνος*, the sense then being that as wine is mixed with spices and labelled as any one pleases, so God receives different names under different forms (p. 188). Bywater, following Bernays (Rhein. Mus. ix. 245), inserts *θύωμα*, and Zeller (Vol. 1, p. 602, 2) reads *ὅκως ἀήρ* for *ὅκωσπερ*. Teichmüller (Vol. 1, p. 67) attempts to save the original reading by making *ὁ θεός*, (*i. e.* fire) the subject both of *ἀλλοιοῦται* and *συμμιγῇ*. The correction of Bernays is the most satisfactory; the meaning then being, that as when perfumes are mixed, the mixture is named according to the scent that impresses each person, so God is named according to the attribute that most impresses the individual. Compare frag. 65. About the same sense, however, is derived from the other readings.

Fragment 38.

Note 15.—Schleiermacher and Zeller think it doubtful whether any sense can be made out of this fragment. For Schuster's fanciful explanation, see Introduction, p. 577 f. Bernays (Rhein. Mus. ix. p. 265, 6) interprets it to mean that the perception of fire, upon which depends the existence of the soul, is gained after death and the extinction of the sense of sight, by the sense of smell, just as the passage from Aristotle (frag. 37) teaches that in the conflagration of the world, all perception will be by the nostrils. Pfleiderer (p. 218) suggests *ὁσιοῦνται* for *ὀσμῶνται*.

Fragment 40.

Note 16.—Of this passage from Plutarch only the words *σκίδνησι καὶ συνάγει, πρόσεισι καὶ ἄπεισι*, can with any certainty be attributed directly to Heraclitus. The rest bears marks of later hands, as shown by Bernays (Heraklit. Briefe, p. 55), and Zeller (Vol. 1, p. 576, 2).

Fragment 45.

Note 17.—Bernays' explanation of this passage (Rhein. Mus. vii. p. 94 ; compare Introduction, p. 603 f.) has been followed by Zeller, Schuster (partly), and Arnold Hug. According to this interpretation, the association of the bow and lyre lies in their form, which in the case of the old Greek or Scythian bow with its arms bent back at the ends, was like that of the lyre. Hence we have in the bow and the lyre, two distinct illustrations of harmony by opposite straining tension. Lassalle (Vol. 1, p. 113) understands it to refer to the harmony *between* the bow and the lyre; the bow and the lyre being symbols in the Apollo cult, the one of singularity and difference, the other, of universality and union. On Pfleiderer's modification of Lassalle's view, see Introduction, p. 603. In place of *τόξου καὶ λύρης*, Bast reads *τοῦ ὀξέος τε καὶ βαρέος*. Bergk conjectures *τόξου καὶ νευρῆς*. On the interpretation of this passage by Plutarch and Plato's Eryximachus as the harmony of sharps and flats in music, compare Hug (Platons Symposion, p. 77, 5) and Zeller (Vol. 1, p. 578, 2). Compare frags. 56, 43, 59.

Fragment 47.

Note 18.—Schuster (p. 24, note) reads *ἐς τί γὰρ φησίν, ἁρμονίη ἀφανὴς φανερῆς κρείττων* ; See Introduction, p. 579, and Zeller, Vol. 1, p. 604, 1.

Fragment 50.

Note 19.—MS reads *γραφέων* ; Duncker and Bywater, *γναφέων* ; Bernays, *γναφείῳ*.

Fragment 55.

Note 20.—The common reading is *πᾶν ἑρπετὸν τὴν γῆν νέμεται*, which Zeller retains, understanding it to refer to the beastliness of men, who "feed upon the earth like the worm" (Vol. 1, p. 660). Pfleiderer likewise accepts this reading, quoting Sallust, Catil. 1: Vitam silentio transeunt veluti pecora, quae natura prona atque ventri obedientia finxit. That *πληγῇ*, the reading of Stobaeus, followed by Bywater, is correct, however, is shown by comparison with Æschylus, Ag. 358, *Διὸς πλαγὰν ἔχουσιν εἰπεῖν*, and Plato's Criti. 109 B, *καθάπερ ποιμένες κτήνη πληγῇ νέμοντες*. With this reading, the sense then becomes that man is subject to eternal divine force or law.

Fragment 56.

Note 21.—Compare frag. 45 and note 17. Bywater reads παλίντονος ἁρμονίη, here; but though in three passages, those namely given under this fragment, παλίντονος is found in the MSS, yet the context even in Plutarch, where sharps and flats are spoken of, calls for the meaning "harmony of oppositions," as explained in note 17, for which we should expect παλίντροπος rather than παλίντονος.

Fragment 60.

Note 22.—What is referred to by ταῦτα, "these things," has been questioned. Teichmüller, followed by Pfleiderer, has given the true explanation. Ταῦτα refers to some idea the opposite of "justice." Clement is illustrating the Pauline principle that without law there would have been no sin. For this, Heraclitus, whose prominent thought was, no war without peace, no good without bad, etc., served him as good authority.

Fragment 62.

Note 23.—The original text is as follows: Εἰ δὲ χρὴ τὸν πόλεμον ἐόντα ξυνὸν καὶ δίκην ἐρεῖν καὶ γινόμενα πάντα κατ' ἔριν καὶ χρεώμενα. Schleiermacher proposes εἰδέναι for εἰ δέ and ἔριν for ἐρεῖν, and has been followed by Zeller, Bywater and others. Schuster retains the MS form in the first clause. Χρεώμενα also gives trouble. Brandis proposes σωζόμενα. Schuster reads καταχρεώμενα, approved by Zeller. Lassalle and Bywater retain χρεώμενα. This passive use is unusual, but possible, as shown by the analogy of καταχρεώμενα. The translations of Schuster and Lassalle are as follows:

Schuster (p. 198)—"In dem Falle muss man also den gemeinsamen Krieg sogar Recht nennen und [sagen] das alles [nur] in Folge des Streites entsteht und sich aufbraucht."

Lassalle—"Man muss wissen dass der Krieg das Gemeinsam ist, und der Streit das Recht, und dass nach dem Gesetz des Streits alles wird und verwendet wird (or lit. und sich bethätigt)."

Ξυνός in this passage has almost the signification "common good."

Fragment 64.

Note 24.—Critics have expended their ingenuity in trying to make something out of this obscure fragment. Teichmüller (Vol. 1, p. 97 ff.) says that we have here the distinction of the intelligible from the sensible world. The former is the pure, light, fiery and most incorporeal being, compared with which the world of the senses is death. Zeller (Vol. 1, p. 651) similarly refers it to the testimony of the senses, which see the world as something "stiff and dead," when really everything is in constant motion. Schuster (p. 276) labors with a far-fetched interpretation to show that the passage does *not*

cast any disparagement upon the senses. For Pfleiderer's explanation, see Introduction, p. 602. All these interpretations look for a theoretical meaning, when it is quite possible that no theoretical meaning was intended. It is simpler to compare it with frag. 2, and refer it to Heraclitus' repeated charge against the people, of their sleep-like condition when awake.

Fragment 65.

Note 25.—We have followed Schuster's punctuation of this fragment. Bywater, with other critics, reads, Ἓν τὸ σοφὸν μοῦνον λέγεσθαι οὐκ ἐθέλει καὶ ἐθέλει Ζηνὸς οὔνομα. Τὸ σοφόν, here, is the world-ruling Wisdom or Order, to which Heraclitus applies many names. (See Introduction, p. 619 f.) It wills and wills not to be called by the name of Zeus, because that name, while it points towards its true nature, yet but partly indicates it, or in part wrongly. The variety of meanings, however, which have been drawn from this fragment may be shown by the following translations. Schleiermacher (and Lassalle): "Das Eine Weise allein will nicht ausgesprochen werden und will ausgesprochen werden, der Name des Zeus." Schuster: "Nur eines ist die Weisheit; sie lässt sich nicht und lasst sich doch auch wieder benennen mit des Zeus Namen." Bernays: "Eines, das allein Weise, will und will auch nicht mit des Ζῆν Namen genannt werden." The poetical form Ζηνός is chosen, thinks Bernays, to indicate that the One Wise is the source of "life." Zeller: "Eines, das allein Weise, will und will auch nicht mit dem Namen des Zeus benannt werden." Pfleiderer: "Als Eins will das weise Allwesen, Zeus genannt, nicht bezeichnet werden und will es." Teichmüller: "Die Weisheit, Zeus genannt, will allein eins heissen und will es auch nicht."

Fragment 72.

Note 26.—This fragment is connected by Schuster and Zeller with the group of passages concerning rest in change (see frags. 82, 83), and refers to the pleasure which the rest and change of death bring to souls. They therefore reject the μὴ θάνατον of Numenius as not Heraclitic. (Schuster, p. 191, 1. Zeller, p. 647, 2.) Pfleiderer, however (p. 222), retains the μὴ θάνατον as genuine, and explains that it is a pleasure to souls to become wet, because so by pursuing the way down into apparent death, they attain their new birth of life in death. He therefore retains also the τέρψιν δὲ εἶναι αὐταῖς τὴν εἰς τὴν γένεσιν πτῶσιν, of Numenius, as expressing the true sense of the passage.

Fragment 74.

Note 27.—The added clause of Plutarch, "It flashes through the body like lightning through the clouds," is also regarded by Schleiermacher, Schuster, Zeller, and Pfleiderer, as Heraclitic.

The similarity of the three fragments 74, 75, and 76 suggests, of course, that they are all corrupted forms of a common original. Bywater, however, accepts the form of expression in frag. 74 as surely Heraclitic and marks the other two as doubtful. Schleiermacher, from the number of citations of each of these fragments, concludes that Heraclitus had expressed himself in each of these three forms. Lassalle, in agreeing with him, believes also that Heraclitus, who was given to playing upon words (for further examples of Heraclitus' puns, compare frags. 91, 101, 127, 66), not without purpose chose the words *αὔη* and *αὐγή*, and sees in the use of the latter word a reference to the lightning-like movement of the soul (Vol. 2, p. 196 f.). Zeller thinks it difficult to determine the original form, but he does not regard the proposition *αὐγὴ ξηρὴ ψυχὴ σοφωτάτη*, as Heraclitic (Vol. 1, p. 643, 2).

Fragment 77.

Note 28.—The original of this difficult and corrupted passage as it appears in Clement, is as follows (unpunctuated), *Ἄνθρωπος ἐν εὐφρόνῃ φάος ἅπτεται ἑαυτῷ ἀποθανὼν ἀποσβεσθεὶς ζῶν δὲ ἅπτεται τεθνεῶτος εὕδων ἀποσβεσθεὶς ὄψεις ἐγρηγορὼς ἅπτεται εὕδοντος.* Various emendations and translations of this have been made. Compare Schuster, p. 271; Pfleiderer, p. 204, 1. Bywater, however, finally rescues as Heraclitic the form given above in the text.

Fragment 80.

Note 29.—That this fragment is to be taken in the sense in which Diogenes understands it, rather than in that of Plutarch, is held by Schuster (p. 61) and Zeller (Vol. 1, p. 654, 4). Lassalle (Vol. 1, p. 301), following Schleiermacher, takes it as Clement does, in the sense of the Delphic inscription, "I have sought myself in the general flux of things, I have striven to know myself." For Pfleiderer's interpretation and the true meaning, see Introduction, pp. 600, 607.

Fragment 82.

Note 30.—Lassalle, following Creuzer, reads *ἄγχεσθαι* instead of *ἄρχεσθαι* (Vol. 1, p. 131.)

Fragment 90.

Note 31.—Lassalle (Vol. 1, p. 290) interprets this fragment as follows: In waking, we distinguish our own representations from the objective world common to all. In sleeping, they are one and the same. Hence Heraclitus says the sleeping make their own world. Similarly Pfleiderer (p. 202 f.) understands Heraclitus to mean that the sleeper makes his own world, while the waking man is conscious that corresponding to his world of ideas there is a common

objective world. Pfleiderer rejects *καὶ συνεργοὺς* as an addition of Aurelius.

FRAGMENT 97.

Note 32.—This fragment has given trouble. Bernays (Heraclitea 15) proposes to substitute *δαήμονος* for *δαίμονος*, but has not been followed by other critics. Schleiermacher translates, "Ein thörichter Mann vernimmt nicht mehr von Schicksal als ein Kind von einem Mann." Schuster (p. 342) renders, "Der Mensch in seiner Kindheit hat (sie [*i. e.* the names]) von Gott gehört, wie (jetzt) das Kind von dem Manne," and finds here support for the theory of the natural fitness of names (see Introduction, p. 575), which primitive man learned directly from Nature. Zeller (Vol. 1, p. 653) refers it to the childish want of reason in man, which does not perceive the voice of the deity. Pfleiderer (p. 51) renders, "Der unverständige Mensch hat von jeher nur soviel von der Gottheit gehört, als ein Kind vom Manne."

FRAGMENT 103.

Note 33.—*Ὕβριν* here is to be taken in the sense of excess of self-assertion, the private will against the universal Law. Compare frags. 92, 104, etc.

FRAGMENT 107.

Note 34.—The latter clause may also be translated, "Wisdom is to speak and act truly, giving ear to Nature."

FRAGMENT 110.

Note 35.—Clementine MS reads *βουλῄ*. Eusebius, followed by all but Mullach, reads *βουλῇ*. For Heraclitus' opinions on democracy, see, further, frags. 114, 113.

FRAGMENT 116.

Note 36.—The passage in Clement is as follows: *ἀλλὰ τὰ μὲν τῆς γνώσεως βάθη κρύπτειν ἀπιστίη ἀγαθή, καθ' Ἡράκλειτον· ἀπιστίη γὰρ διαφυγγάνει μὴ γιγνώσκεσθαι*, from which it is seen that the words of Heraclitus, *ἀπιστίη διαφυγγάνει μὴ γιγνώσκεσθαι*, were differently understood by Clement and Plutarch. Schuster (p. 72) accepts the Clementine form, and regards the whole passage as Heraclitic, and renders, "Die Tiefe der Erkenntniss zu verbergen, das ist ein gutes Misstrauen. Denn durch diese misstrauische Behutsamkeit entgeht man dem Schicksal durchschaut zu werden," by which he accounts for the (intentional) obscurity of Heraclitus' writings. Zeller (Vol. 1, p. 574, 2), following Schleiermacher, rejects the Clementine version, and regards the words as teaching that truth is hidden from the masses because it seems incredible to them. A still different meaning may be found in the words if we take *ἀπιστίη* as subjective, referring to the want of faith which prevents us from seeing truth.

FRAGMENT 118.

Note 37.—The common reading is, *δοκεόντων ὁ δοκιμώτατος γινώσκει φυλάσσειν*, which makes nonsense. Schleiermacher proposes *δοκέοντα ὁ δοκιμώτατος γινώσκειν φυλάσσειν*. Schuster (p. 340) suggests, *δοκεόντων, ὁ δοκιμώτατον γίνεται, γινώσκει φυλάσσειν*, and fancies the allusion is to the poets, who from credible things accept that which is most credible. Bergk, followed by Pfleiderer, reads *φλυάσσειν*, to talk nonsense. Bernays, followed by Bywater, reads *πλάσσειν*.

FRAGMENT 121.

Note 38.—This fragment has been variously translated, but the meaning seems to be that a man's God or Destiny depends not upon external divine powers, but upon his own inner nature. Teichmüller finds here the further meaning that the essence of mind is the essence of deity.

FRAGMENT 123.

Note 39.—The meaning of this passage is very doubtful. We have followed Bernays' reading instead of the common *ἔνθα δεόντι*, which Bywater retains, although he marks it uncertain. Schuster (p. 176, 1) suggests [*δαίμων ἐθέλει*] *ἔνθαδε ἐόντι ἐπιίσταсθαι καὶ φυλακὸς κ. τ. λ.* Zeller (Vol. 1, p. 648, 4) regards it as a reference to the dæmons who are made protectors of men. Lassalle (Vol. 1, p. 185) thinks it refers to a resurrection of souls.

FRAGMENT 127.

Note 40.—For text and discussion of this passage, see Introduction, p. 611 ff. Teichmüller's interpretation of it is as follows: "Wenn es nicht Dionysus wäre, dem sie die Procession führen und dabei das Lied auf die Schamglieder singen, so wäre das Schamloseste ausgeführt. Nun aber, ist Hades (der Sohn der Scham) derselbe wie Dionysus, dem sie rasen und Feste feiern." This means, says Teichmüller, that the shameful and the becoming are the same (Identification of opposites). For what is improper for men is proper for Dionysus, because he is the same as Hades, and Hades is the same as shame, which latter he attempts to prove from Plutarch, de Is. 29 b. Again, Dionysus and Hades are the same, because the former stands for the sun and the latter for the lower world, and as the sun is absorbed into the earth at night and generated therefrom in the morning, they must be essentially the same. (Neue Studien, Vol. 1, p. 25.)

FRAGMENT 129.

Note 41.—That the use of this term was ironical, is made probable by the following fragment.

ΗΡΑΚΛΕΙΤΟΥ ΕΦΕΣΙΟΥ

ΠΕΡΙ ΦΥΣΕΩΣ.

I. Οὐκ ἐμεῦ ἀλλὰ τοῦ λόγου ἀκούσαντας ὁμολογέειν σοφόν ἐστι, ἓν πάντα εἶναι.

II. Τοῦ δὲ λόγου τοῦδ' ἐόντος αἰεὶ ἀξύνετοι γίγνονται ἄνθρωποι καὶ πρόσθεν ἢ ἀκοῦσαι καὶ ἀκούσαντες τὸ πρῶτον. γινομένων γὰρ πάντων κατὰ τὸν λόγον τόνδε ἀπείροισι ἐοίκασι πειρώμενοι καὶ ἐπέων καὶ ἔργων τοιουτέων ὁκοίων ἐγὼ διηγεῦμαι, διαιρέων ἕκαστον κατὰ φύσιν καὶ φράζων ὅκως ἔχει. τοὺς δὲ ἄλλους ἀνθρώπους λανθάνει ὁκόσα ἐγερθέντες ποιέουσι, ὅκωσπερ ὁκόσα εὕδοντες ἐπιλανθάνονται.

III. Ἀξύνετοι ἀκούσαντες κωφοῖσι ἐοίκασι· φάτις αὐτοῖσι μαρτυρέει παρεόντας ἀπεῖναι.

IV. Κακοὶ μάρτυρες ἀνθρώποισι ὀφθαλμοὶ καὶ ὦτα, βαρβάρους ψυχὰς ἐχόντων.

V. Οὐ φρονέουσι τοιαῦτα πολλοὶ ὁκόσοισι ἐγκυρέουσι οὐδὲ μαθόντες γινώσκουσι, ἑωυτοῖσι δὲ δοκέουσι.

VI. Ἀκοῦσαι οὐκ ἐπιστάμενοι οὐδ' εἰπεῖν.

VII. Ἐὰν μὴ ἔλπηαι, ἀνέλπιστον οὐκ ἐξευρήσει, ἀνεξερεύνητον ἐὸν καὶ ἄπορον.

VIII. Χρυσὸν οἱ διζήμενοι γῆν πολλὴν ὀρύσσουσι καὶ εὑρίσκουσι ὀλίγον.

IX. Ἀγχιβασίην.

X. Φύσις κρύπτεσθαι φιλεῖ.

XI. Ὁ ἄναξ οὗ τὸ μαντεῖόν ἐστι τὸ ἐν Δελφοῖς, οὔτε λέγει οὔτε κρύπτει, ἀλλὰ σημαίνει.

XII. Σίβυλλα δὲ μαινομένῳ στόματι ἀγέλαστα καὶ ἀκαλλώπιστα καὶ ἀμύριστα φθεγγομένη χιλίων ἐτέων ἐξικνέεται τῇ φωνῇ διὰ τὸν θεόν.

XIII. Ὅσων ὄψις ἀκοὴ μάθησις, ταῦτα ἐγὼ προτιμέω.

XIV. Polybius iv. 40: τοῦτο γὰρ ἴδιόν ἐστι τῶν νῦν καιρῶν, ἐν οἷς πάντων πλωτῶν καὶ πορευτῶν γεγονότων οὐκ ἂν ἔτι πρέπον εἴη ποιηταῖς καὶ

μυθογράφοις χρῆσθαι μάρτυσι περὶ τῶν αγνοουμένων, ὅπερ οἱ πρὸ ἡμῶν περὶ τῶν πλείστων, ἀπίστους ἀμφισβητουμένων παρεχόμενοι βεβαιωτὰς κατὰ τὸν Ἡράκλειτον.

XV. Ὀφθαλμοὶ τῶν ὤτων ἀκριβέστεροι μάρτυρες.

XVI. Πολυμαθίη νόον ἔχειν οὐ διδάσκει· Ἡσίοδον γὰρ ἂν ἐδίδαξε καὶ Πυθαγόρην αὖτίς τε Ξενοφάνεα καὶ Ἑκαταῖον.

XVII. Πυθαγόρης Μνησάρχου ἱστορίην ἤσκησε ἀνθρώπων μάλιστα πάντων. καὶ ἐκλεξάμενος ταύτας τὰς συγγραφὰς ἐποίησε ἑωυτοῦ σοφίην, πολυμαθίην, κακοτεχνίην.

XVIII. Ὁκόσων λόγους ἤκουσα οὐδεὶς ἀφικνέεται ἐς τοῦτο, ὥστε γινώσκειν ὅτι σοφόν ἐστι πάντων κεχωρισμένον.

XIX. Ἓν τὸ σοφόν, ἐπίστασθαι γνώμην ᾗ κυβερνᾶται πάντα διὰ πάντων.

XX. Κόσμον < τόνδε > τὸν αὐτὸν ἁπάντων οὔτε τις θεῶν οὔτε ἀνθρώπων ἐποίησε, ἀλλ' ἦν αἰεὶ καὶ ἔστι καὶ ἔσται πῦρ ἀείζωον, ἁπτόμενον μέτρα καὶ ἀποσβεννύμενον μέτρα.

XXI. Πυρὸς τροπαὶ πρῶτον θάλασσα· θαλάσσης δὲ τὸ μὲν ἥμισυ γῆ, τὸ δὲ ἥμισυ πρηστήρ.

XXII. Πυρὸς ἀνταμείβεται πάντα καὶ πῦρ ἁπάντων, ὥσπερ χρυσοῦ χρήματα καὶ χρημάτων χρυσός.

XXIII. Θάλασσα διαχέεται καὶ μετρέεται ἐς τὸν αὐτὸν λόγον ὁκοῖος πρόσθεν ἦν ἢ γενέσθαι †γῆ†.

XXIV. Χρησμοσύνη . . . κόρος.

XXV. Ζῇ πῦρ τὸν γῆς θάνατον, καὶ ἀὴρ ζῇ τὸν πυρὸς θάνατον· ὕδωρ ζῇ τὸν ἀέρος θάνατον, γῆ τὸν ὕδατος.

XXVI. Πάντα τὸ πῦρ ἐπελθὸν κρινέει καὶ καταλήψεται.

XXVII. Τὸ μὴ δῦνόν ποτε πῶς ἄν τις λάθοι;

XXVIII. Τὰ δὲ πάντα οἰακίζει κεραυνός.

XXIX. Ἥλιος οὐχ ὑπερβήσεται μέτρα· εἰ δὲ μή, Ἐρινύες μιν δίκης ἐπίκουροι ἐξευρήσουσι.

XXX. Ἠοῦς καὶ ἑσπέρης τέρματα ἡ ἄρκτος, καὶ ἀντίον τῆς ἄρκτου οὖρος αἰθρίου Διός.

XXXI. Εἰ μὴ ἥλιος ἦν, εὐφρόνη ἂν ἦν.

XXXII. Νέος ἐφ' ἡμέρῃ ἥλιος.

XXXIII. Diogenes Laert. i. 23: δοκεῖ δὲ (scil. Θαλῆς) κατά τινας πρῶτος ἀστρολογῆσαι καὶ ἡλιακὰς ἐκλείψεις καὶ τροπὰς προειπεῖν, ὥς φησιν Εὔδημος ἐν τῇ περὶ τῶν ἀστρολογουμένων ἱστορίᾳ· ὅθεν αὐτὸν καὶ Ξενοφάνης καὶ Ἡρόδοτος θαυμάζει. μαρτυρεῖ δ' αὐτῷ καὶ Ἡράκλειτος καὶ Δημόκριτος.

XXXIV. Plutarchus Qu. Plat. viii. 4, p. 1007: οὕτως οὖν ἀναγκαίαν πρὸς τὸν οὐρανὸν ἔχων συμπλοκὴν καὶ συναρμογὴν ὁ χρόνος οὐχ ἁπλῶς ἐστι κίνησις ἀλλ', ὥσπερ εἴρηται, κίνησις ἐν τάξει μετρον ἐχούσῃ καὶ πέρατα καὶ περιόδους. ὧν ὁ ἥλιος ἐπιστάτης ὢν καὶ σκοπός, ὁρίζειν καὶ βραβευειν καὶ ἀναδεικνύναι καὶ ἀναφαίνειν μεταβολὰς καὶ ὥρας αἳ πάντα φέρουσι, καθ' Ἡράκλειτον, οὐδὲ φαύλων οὐδὲ μικρῶν, ἀλλὰ τῶν μεγίστων καὶ κυριωτάτων τῷ ἡγεμόνι καὶ πρώτῳ θεῷ γίνεται συνεργός.

XXXV. Διδάσκαλος δὲ πλείστων Ἡσίοδος· τοῦτον ἐπίστανται πλεῖστα εἰδέναι, ὅστις ἡμέρην καὶ εὐφρόνην οὐκ ἐγίνωσκε· ἔστι γὰρ ἕν.

XXXVI. Ὁ θεὸς ἡμέρη εὐφρόνη, χειμὼν θέρος, πόλεμος εἰρήνη, κόρος λιμός· ἀλλοιοῦται δὲ ὅκωσπερ ὁκόταν συμμιγῇ < θυωμα > θυώμασι· ὀνομάζεται καθ' ἡδονὴν ἑκάστου.

XXXVII. Aristoteles de Sensu 5, p. 443 a 21: δοκεῖ δ' ἐνίοις ἡ καπνώδης ἀναθυμίασις εἶναι ὀσμή, οὖσα κοινὴ γῆς τε καὶ ἀέρος. καὶ πάντες ἐπιφέρονται ἐπὶ τοῦτο περὶ ὀσμῆς· διὸ καὶ Ἡράκλειτος οὕτως εἴρηκεν, ὡς εἰ πάντα τὰ ὄντα καπνὸς γένοιτο, ῥῖνες ἂν διαγνοῖεν.

XXXVIII. Αἱ ψυχαὶ ὀσμῶνται καθ' ᾅδην.

XXXIX. Τὰ ψυχρὰ θέρεται, θερμὸν ψύχεται, ὑγρὸν αὑαίνεται, καρφαλέον νοτίζεται.

XL. Σκίδνησι καὶ συνάγει, πρόσεισι καὶ ἄπεισι.

XLI. Ποταμοῖσι δὶς τοῖσι αὐτοῖσι οὐκ ἂν ἐμβαίης· ἕτερα γὰρ < καὶ ἕτερα > ἐπιρρέει ὕδατα.

XLII. † Ποταμοῖσι τοῖσι αὐτοῖσι ἐμβαίνουσιν ἕτερα καὶ ἕτερα ὕδατα ἐπιρρεῖ †.

XLIII. Aristoteles Eth. Eud. vii. 1, p. 1235 a 26: καὶ Ἡράκλειτος ἐπιτιμᾷ τῷ ποιήσαντι· ὡς ἔρις ἔκ τε θεῶν καὶ ἀνθρώπων ἀπόλοιτο· οὐ γὰρ ἂν εἶναι ἁρμονίαν μὴ ὄντος ὀξέος καὶ βαρέος, οὐδὲ τὰ ζῷα ἄνευ θήλεος καὶ ἄρρενος, ἐναντίων ὄντων.

XLIV. *Πόλεμος πάντων μὲν πατήρ ἐστι πάντων δὲ βασιλεύς, καὶ τοὺς μὲν θεοὺς ἔδειξε τοὺς δὲ ἀνθρώπους, τοὺς μὲν δούλους ἐποίησε τοὺς δὲ ἐλευθέρους.*

XLV. *Οὐ ξυνίασι ὅκως διαφερόμενον ἑωυτῷ ὁμολογέει· παλίντροπος ἁρμονίη ὅκωσπερ τόξου καὶ λύρης.*

XLVI. Aristoteles Eth. Nic. viii. 2, p. 1155 b 1: *καὶ περὶ αὐτῶν τούτων ἀνώτερον ἐπιζητοῦσι καὶ φυσικώτερον· Εὐριπίδης μὲν φάσκων ἐρᾶν μὲν ὄμβρου γαῖαν ξηρανθεῖσαν, ἐρᾶν δὲ σεμνὸν οὐρανὸν πληρούμενον ὄμβρου πεσεῖν ἐς γαῖαν· καὶ Ἡράκλειτος τὸ ἀντίξουν συμφέρον, καὶ ἐκ τῶν διαφερόντων καλλίστην ἁρμονίαν, καὶ πάντα κατ' ἔριν γίνεσθαι.*

XLVII. *Ἁρμονίη ἀφανὴς φανερῆς κρείσσων.*

XLVIII. *Μὴ εἰκῆ περὶ τῶν μεγίστων συμβαλώμεθα.*

XLIX. *Χρὴ εὖ μάλα πολλῶν ἵστορας φιλοσόφους ἄνδρας εἶναι.*

L. *Γναφέων ὁδὸς εὐθεῖα καὶ σκολιὴ μία ἐστὶ καὶ ἡ αὐτή.*

LI. *Ὄνοι σύρματ' ἂν ἕλοιντο μᾶλλον ἢ χρυσόν.*

LII. *Θάλασσα ὕδωρ καθαρώτατον καὶ μιαρώτατον, ἰχθύσι μὲν πότιμον καὶ σωτήριον, ἀνθρώποις δὲ ἄποτον καὶ ὀλέθριον.*

LIII. Columella de R. R. viii. 4: siccus etiam pulvis et cinis, ubicunque cohortem porticus vel tectum protegit, iuxta parietes reponendus est, ut sit quo aves se perfundant: nam his rebus plumam pinnasque emendant, si modo credimus Ephesio Heraclito qui ait: sues coeno, cohortales aves pulvere (vel cinere) lavari.

LIV. *Βορβόρῳ χαίρειν.*

LV. *Πᾶν ἑρπετὸν πληγῇ νέμεται.*

LVI. *Παλίντροπος ἁρμονίη κόσμου ὅκωσπερ λύρης καὶ τόξου.*

LVII. *Ἀγαθὸν καὶ κακὸν ταὐτόν.*

LVIII. Hippolytus Ref. haer. ix. 10: *καὶ ἀγαθὸν καὶ κακόν* (scil. *ἕν ἐστι*)· *οἱ γοῦν ἰατροί, φησὶν ὁ Ἡράκλειτος, τέμνοντες καίοντες πάντη βασανίζοντες κακῶς τοὺς ἀρρωστοῦντας ἐπαιτιῶνται μηδέν' ἄξιον μισθὸν λαμβάνειν παρὰ τῶν ἀρρωστούντων, ταῦτα ἐργαζόμενοι τὰ ἀγαθὰ καὶ † τὰς νόσους †.*

LIX. Συνάψειας οὖλα καὶ οὐχὶ οὖλα, συμφερόμενον διαφερόμενον, συνᾷδον διᾷδον· ἐκ πάντων ἓν καὶ ἐξ ἑνὸς πάντα.

LX. Δίκης οὔνομα οὐκ ἂν ᾔδεσαν, εἰ ταῦτα μὴ ἦν.

LXI. Schol. B. in Il. iv. 4, p. 120 Bekk.: ἀπρεπές φασιν, εἰ τέρπει τοὺς θεοὺς πολέμων θέα. ἀλλ' οὐκ ἀπρεπές· τὰ γὰρ γενναῖα ἔργα τέρπει. ἄλλως τε πόλεμοι καὶ μάχαι ἡμῖν μὲν δεινὰ δοκεῖ, τῷ δὲ θεῷ οὐδὲ ταῦτα δεινά. συντελεῖ γὰρ ἅπαντα ὁ θεὸς πρὸς ἁρμονίαν τῶν ὅλων, οἰκονομῶν τὰ συμφέροντα, ὅπερ καὶ Ἡράκλειτος λέγει, ὡς τῷ μὲν θεῷ καλὰ πάντα καὶ ἀγαθὰ καὶ δίκαια, ἄνθρωποι δὲ ἃ μὲν ἄδικα ὑπειλήφασιν, ἃ δὲ δίκαια.

LXII. Εἰδέναι χρὴ τὸν πόλεμον ἐόντα ξυνόν, καὶ δίκην ἔριν· καὶ γινόμενα πάντα κατ' ἔριν καὶ † χρεώμενα †.

LXIII. Ἔστι γὰρ εἱμαρμένα πάντως * * * *.

LXIV. Θάνατός ἐστι ὁκόσα ἐγερθέντες ὁρέομεν, ὁκόσα δὲ εὕδοντες ὕπνος.

LXV. Ἓν τὸ σοφὸν μοῦνον· λέγεσθαι οὐκ ἐθέλει καὶ ἐθέλει Ζηνὸς οὔνομα.

LXVI. Τοῦ βιοῦ οὔνομα βίος, ἔργον δὲ θάνατος.

LXVII. Ἀθάνατοι θνητοί, θνητοὶ ἀθάνατοι, ζῶντες τὸν ἐκείνων θάνατον τὸν δὲ ἐκείνων βίον τεθνεῶτες.

LXVIII. Ψυχῇσι γὰρ θάνατος ὕδωρ γενέσθαι, ὕδατι δὲ θάνατος γῆν γενέσθαι· ἐκ γῆς δὲ ὕδωρ γίνεται, ἐξ ὕδατος δὲ ψυχή.

LXIX. Ὁδὸς ἄνω κάτω μία καὶ ὡυτή.

LXX. Ξυνὸν ἀρχὴ καὶ πέρας.

LXXI. Ψυχῆς πείρατα οὐκ ἂν ἐξεύροιο πᾶσαν ἐπιπορευόμενος ὁδόν.

LXXII. Ψυχῇσι τέρψις ὑγρῇσι γενέσθαι.

LXXIII. Ἀνὴρ ὁκότ' ἂν μεθυσθῇ, ἄγεται ὑπὸ παιδὸς ἀνήβου σφαλλόμενος, οὐκ ἐπαΐων ὄκη βαίνει, ὑγρὴν τὴν ψυχὴν ἔχων.

LXXIV. Αὔη ψυχὴ σοφωτάτη καὶ ἀρίστη.

LXXV. † Αὐγὴ ξηρὴ ψυχὴ σοφωτάτη καὶ ἀρίστη †.

LXXVI. † Οὗ γῆ ξηρή, ψυχὴ σοφωτάτη καὶ ἀρίστη †.

LXXVII. Ἄνθρωπος, ὅκως ἐν εὐφρόνῃ φάος, ἅπτεται ἀποσβέννυται.

LXXVIII. Plutarchus Consol. ad Apoll. 10, p. 106: πότε γὰρ ἐν ἡμῖν αὐτοῖς οὐκ ἔστιν ὁ θάνατος; καὶ ᾗ φησιν Ἡράκλειτος, ταὔτ' εἶναι

ζῶν καὶ τεθνηκός, καὶ τὸ ἐγρηγορὸς καὶ τὸ καθεῦδον, καὶ νέον καὶ γηραιόν· τάδε γὰρ μεταπεσόντα ἐκεῖνά ἐστι κἀκεῖνα πάλιν μεταπεσόντα ταῦτα.

LXXIX. Αἰὼν παῖς ἐστι παίζων πεσσεύων· παιδὸς ἡ βασιληίη.

LXXX. Ἐδιζησάμην ἐμεωυτόν.

LXXXI. Ποταμοῖσι τοῖσι αὐτοῖσι ἐμβαίνομέν τε καὶ οὐκ ἐμβαίνομεν, εἶμέν τε καὶ οὐκ εἶμεν.

LXXXII. Κάματός ἐστι τοῖς αὐτοῖς μοχθεῖν καὶ ἄρχεσθαι.

LXXXIII. Μεταβάλλον ἀναπαύεται.

LXXXIV. Καὶ ὁ κυκεὼν διίσταται μὴ κινεόμενος.

LXXXV. Νέκυες κοπρίων ἐκβλητότεροι.

LXXXVI. Γενόμενοι ζώειν ἐθέλουσι μόρους τ' ἔχειν· μᾶλλον δὲ ἀναπαύεσθαι, καὶ παῖδας καταλείπουσι μόρους γενέσθαι.

LXXXVII. Plutarchus de Orac. def. 11, p. 415: οἱ μὲν "ἡβώντος" ἀναγινώσκοντες (apud Hesiod. fr. 163 Goettling) ἔτη τριάκοντα ποιοῦσι τὴν γενεὰν καθ' Ἡράκλειτον· ἐν ᾧ χρόνῳ γεννῶντα παρέχει τὸν ἐξ αὐτοῦ γεγεννημένον ὁ γεννήσας.

LXXXVIII. Io. Lydus de Mensibus iii. 10, p. 37 ed. Bonn: ὁ τριάκοντα ἀριθμὸς φυσικώτατός ἐστιν· ὃ γὰρ ἐν μονάσι τριάς, τοῦτο ἐν δεκάσι τριακοντάς. ἐπεὶ καὶ ὁ τοῦ μηνὸς κύκλος συνέστηκεν ἐκ τεσσάρων τῶν ἀπὸ μονάδος ἑξῆς τετραγώνων α', δ', θ', ις'. ὅθεν οὐκ ἀπὸ σκοποῦ Ἡράκλειτος γενεὰν τὸν μῆνα καλεῖ.

LXXXIX. Ex homine in tricennio potest avus haberi.

XC. M. Antoninus vi. 42: πάντες εἰς ἓν ἀποτέλεσμα συνεργοῦμεν, οἱ μὲν εἰδότως καὶ παρακολουθητικῶς, οἱ δὲ ἀνεπιστάτως· ὥσπερ καὶ τοὺς καθεύδοντας, οἶμαι, ὁ Ἡράκλειτος ἐργάτας εἶναι λέγει καὶ συνεργοὺς τῶν ἐν τῷ κόσμῳ γινομένων.

XCI. Ξυνόν ἐστι πᾶσι τὸ φρονέειν. ξὺν νόῳ λέγοντας ἰσχυρίζεσθαι χρὴ τῷ ξυνῷ πάντων, ὅκωσπερ νόμῳ πόλις καὶ πολὺ ἰσχυροτέρως. τρέφονται γὰρ πάντες οἱ ἀνθρώπειοι νόμοι ὑπὸ ἑνὸς τοῦ θείου· κρατέει γὰρ τοσοῦτον ὁκόσον ἐθέλει καὶ ἐξαρκέει πᾶσι καὶ περιγίνεται.

XCII. Τοῦ λόγου δ' ἐόντος ξυνοῦ, ζώουσι οἱ πολλοὶ ὡς ἰδίην ἔχοντες φρόνησιν.

XCIII. Ὧι μάλιστα διηνεκέως ὁμιλέουσι, τούτῳ διαφέρονται.

XCIV. Οὐ δεῖ ὥσπερ καθεύδοντας ποιεῖν καὶ λέγειν.

XCV. Plutarchus de Superst. 3, p. 166: ὁ Ἡράκλειτός φησι, τοῖς ἐγρηγορόσιν ἕνα καὶ κοινὸν κόσμον εἶναι, τῶν δὲ κοιμωμένων ἕκαστον εἰς ἴδιον ἀποστρέφεσθαι.

XCVI. Ἦθος γὰρ ἀνθρώπειον μὲν οὐκ ἔχει γνώμας, θεῖον δὲ ἔχει.

XCVII. Ἀνὴρ νήπιος ἤκουσε πρὸς δαίμονος ὅκωσπερ παῖς πρὸς ἀνδρός.

XCVIII. Plato Hipp. mai. 289 B: ἢ οὐ καὶ Ἡράκλειτος ταὐτὸν τοῦτο λέγει, ὃν σὺ ἐπάγει, ὅτι ἀνθρώπων ὁ σοφώτατος πρὸς θεὸν πίθηκος φανεῖται καὶ σοφίᾳ καὶ κάλλει καὶ τοῖς ἄλλοις πᾶσιν;

XCIX. Plato Hipp. mai. 289 A: ὦ ἄνθρωπε, ἀγνοεῖς ὅτι τὸ τοῦ Ἡρακλείτου εὖ ἔχει, ὡς ἄρα πιθήκων ὁ κάλλιστος αἰσχρὸς ἄλλῳ γένει συμβάλλειν, καὶ χυτρῶν ἡ καλλίστη αἰσχρὰ παρθένων γένει συμβάλλειν, ὥς φησιν Ἱππίας ὁ σοφός.

C. Μάχεσθαι χρὴ τὸν δῆμον ὑπὲρ τοῦ νόμου ὅκως ὑπὲρ τείχεος.

CI. Μόροι γὰρ μέζονες μέζονας μοίρας λαγχάνουσι.

CII. Ἀρηιφάτους θεοὶ τιμῶσι καὶ ἄνθρωποι.

CIII. Ὕβριν χρὴ σβεννύειν μᾶλλον ἢ πυρκαϊήν.

CIV. Ἀνθρώποισι γίνεσθαι ὁκόσα θέλουσι οὐκ ἄμεινον. νοῦσος ὑγίειαν ἐποίησε ἡδὺ καὶ ἀγαθόν, λιμὸς κόρον, κάματος ἀνάπαυσιν.

CV. Θυμῷ μάχεσθαι χαλεπόν· ὅ τι γὰρ ἂν χρηίζῃ γίνεσθαι, ψυχῆς ὠνέεται.

CVI. † Ἀνθρώποισι πᾶσι μέτεστι γιγνώσκειν ἑαυτοὺς καὶ σωφρονεῖν †.

CVII. † Σωφρονεῖν ἀρετὴ μεγίστη· καὶ σοφίη ἀληθέα λέγειν καὶ ποιεῖν κατὰ φύσιν ἐπαΐοντας †.

CVIII. Ἀμαθίην ἄμεινον κρύπτειν· ἔργον δὲ ἐν ἀνέσει καὶ παρ' οἶνον.

CIX. † Κρύπτειν ἀμαθίην κρέσσον ἢ ἐς τὸ μέσον φέρειν †.

CX. Νόμος καὶ βουλῇ πείθεσθαι ἑνός.

CXI. Τίς γὰρ αὐτῶν νόος ἢ φρήν; [δήμων] ἀοιδοῖσι ἕπονται καὶ διδασκάλῳ χρέωνται ὁμίλῳ, οὐκ εἰδότες ὅτι πολλοὶ κακοὶ ὀλίγοι δὲ ἀγαθοί. αἱρεῦνται γὰρ ἓν ἀντία πάντων οἱ ἄριστοι, κλέος ἀέναον θνητῶν, οἱ δὲ πολλοὶ κεκόρηνται ὅκωσπερ κτήνεα.

CXII. Ἐν Πριήνῃ Βίας ἐγένετο ὁ Τευτάμεω, οὗ πλέων λόγος ἢ τῶν ἄλλων.

CXIII. Εἷς ἐμοὶ μύριοι, ἐὰν ἄριστος ᾖ.

CXIV. Ἄξιον Ἐφεσίοις ἡβηδὸν ἀπάγξασθαι πᾶσι καὶ τοῖς ἀνήβοις τὴν πόλιν καταλιπεῖν, οἵτινες Ἑρμόδωρον ἄνδρα ἑωυτῶν ὀνήιστον ἐξέβαλον, φάντες· ἡμέων μηδὲ εἷς ὀνήιστος ἔστω, εἰ δὲ μή, ἄλλῃ τε καὶ μετ' ἄλλων.

CXV. Κύνες καὶ βαΰζουσι ὃν ἂν μὴ γινώσκωσι.

CXVI. Ἀπιστίῃ διαφυγγάνει μὴ γινώσκεσθαι.

CXVII. Βλὰξ ἄνθρωπος ἐπὶ παντὶ λόγῳ ἐπτοῆσθαι φιλέει.

CXVIII. Δοκεόντων ὁ δοκιμώτατος γινώσκει πλάσσειν· καὶ μέντοι καὶ δίκη καταλήψεται ψευδέων τέκτονας καὶ μάρτυρας.

CXIX. Diogenes Laert. ix. 1: τόν θ' Ὅμηρον ἔφασκεν ἄξιον ἐκ τῶν ἀγώνων ἐκβάλλεσθαι καὶ ῥαπίζεσθαι, καὶ Ἀρχίλοχον ὁμοίως.

CXX. Unus dies par omni est.

CXXI. Ἦθος ἀνθρώπῳ δαίμων.

CXXII. Ἀνθρώπους μένει τελευτήσαντας ἅσσα οὐκ ἔλπονται οὐδὲ δοκέουσι.

CXXIII. Ἔνθαδε ἐόντας ἐπανίστασθαι καὶ φύλακας γίνεσθαι ἐγερτὶ ζώντων καὶ νεκρῶν.

CXXIV. Νυκτιπόλοι, μάγοι, βάκχοι, λῆναι, μύσται.

CXXV. Τὰ γὰρ νομιζόμενα κατ' ἀνθρώπους μυστήρια ἀνιερωστὶ μυεῦνται.

CXXVI. Καὶ τοῖς ἀγάλμασι τουτέοισι εὔχονται, ὁκοῖον εἴ τις τοῖς δόμοισι λεσχηνεύοιτο, οὔ τι γινώσκων θεοὺς οὐδ' ἥρωας, οἵτινές εἰσι.

CXXVII. Εἰ μὴ γὰρ Διονύσῳ πομπὴν ἐποιεῦντο καὶ ὕμνεον ᾆσμα αἰδοίοισι, ἀναιδέστατα εἴργαστ' ἄν· ὡυτὸς δὲ Ἀΐδης καὶ Διόνυσος, ὅτεῳ μαίνονται καὶ ληναΐζουσι.

CXXVIII. Iamblichus de Myst. v. 15: θυσιῶν τοίνυν τίθημι διττὰ εἴδη· τὰ μὲν τῶν ἀποκεκαθαρμένων παντάπασιν ἀνθρώπων, οἷα ἐφ' ἑνὸς ἄν ποτε γένοιτο σπανίως, ὥς φησιν Ἡράκλειτος, ἤ τινων ὀλίγων εὐαριθμήτων ἀνδρῶν· τὰ δ' ἔνυλα καὶ σωματοειδῆ καὶ διὰ μεταβολῆς συνιστάμενα, οἷα τοῖς ἔτι κατεχομένοις ὑπὸ τοῦ σώματος ἁρμόζει.

CXXIX. Ἄκεα.

CXXX. Καθαίρονται δὲ αἵματι μιαινόμενοι ὥσπερ ἂν εἴ τις ἐς πηλὸν ἐμβὰς πηλῷ ἀπονίζοιτο.

PSYCHOLOGICAL LITERATURE.

I.—THE NERVOUS SYSTEM.

The Nervous System and the Mind. A Treatise on the Dynamics of the Human Organism. CHARLES MERCIER. London and New York, 1888. 374 pp.

This book is the outcome of the feeling that the understanding of pathological states in the domain of psychiatry, as in all other domains which have such states, depends, in the first instance, on the grasp of what is normal. We must, in other words, study entire mental processes instead of attending to differences alone. There are three parts to the book ; Part first—The functions of the nervous system, physical and physiological—comprises about one third of the book ; Part second—Functions of the nervous system, psychological —about a quarter ; while the remainder of the book is given to the third part—Mind—and under this heading the main space is taken by a classification of the feelings.

Herbert Spencer and Hughlings-Jackson are the authorities to whom the author is most indebted, and he has certainly been greatly influenced by both. In the introduction his leading idea is laid down in the following form : "Having firmly and tenaciously grasped these two notions of the absolute separateness of mind and matter, and of the invariable concomitance of mental change with a bodily change, the student will enter on the study of psychology with half his difficulties already surmounted." The interest of the author does not appear to be so strong in the physical portion as later on. The deductive physiology which is largely presented in the former is not satisfying. The similes and figures incident to that mode of treatment have a vicious way of getting more credit than is due them, and sometimes pose as real explanations, which cannot but be dangerous to the correct estimation of the argument involved. The avalanche theory, which is brought in from experimental physiology to support certain theoretical views, has been satisfactorily disproved, so that it should not be used for such a purpose.

In the physiological division, the presentation of the Jacksonian distinction of "central" and "peripheral," as applied to movements, makes the important views of that author more accessible than hitherto.

In discussing the functions of the nervous system from a psychological point of view, the author takes up conduct, and, presenting it in an agreeable form and with the good English that characterizes the entire book, makes this portion most readable. The pyschological function of the nervous system is defined as "the adjustment of processes that occur within the organism to conditions that exist outside of it." These adjustments are discussed under the heads of their novelty, complexity, precision, and thriftiness.

In discussing mind, in the last part of the book, the Spencerian view of the proximate constituents as feelings and relations between feelings is the one accepted. Spencer's classification of cognitions is given and criticized at some length, and then follows a discussion of feeling and a classification of the feelings according to the author, which last comprises almost a quarter of the book. The principle of evolutionary differentiation on which the classification is based certainly commends itself, but whatever may be the value of the discussion, it does not seem to belong to the book, and is a far too special study to interest those who will be interested in the other parts.

As an expression of an earnest wish of a large number of alienists to place the study of mental disease on a better footing, the book is satisfactory, for the evident desire to go straight to the point, and the clear, untechnical character of the style, cannot fail to make it useful to those who have the slightest interest in such matters.

Ueber die Verrichtungen des Grosshirns. GOLTZ. Sechste Abhandlung. Pflüger's Archiv, Bd. 42, Heft 9 und 10.

It is now some four years since the fifth contribution of Goltz made its appearance in this same Archiv. Since that time there have been several papers from the Strassburg laboratory along this line. The present paper is subdivided under three general heads: First, the removal of an entire half of the cerebrum; second, the removal of large symmetrical portions in the frontal half of the cerebrum; third, removal of both occipital lobes. Under the first head, Goltz describes a dog which had lost one cerebral hemisphere, basal ganglia included. The animal with this extensive defect lived some fifteen months after the last operation. His condition is described as that of impaired sensibility and motility on the side opposite the lesion, but there was no complete loss of sensibility or paralysis to be anywhere observed. The animal has become a simpleton that never romps, shows no fear, is somewhat deaf, and hemiamblyopic in its single eye (the eye on the side of the operation having been removed).

The simple fact that a dog can survive such a lesion is in itself a matter of interest. Goltz uses this case at the same time to support several lines of argument. In the first place, it has been often objected that his method of operating left parts of the various cortical centres which he claimed to have removed, and that this fact accounted for the retention of the functions which Goltz described. When an entire hemisphere is removed, this argument is answered, and yet the reactions of the dog were the same as in the cases where the objection had been urged. It has further been held by some investigators that the functions normally resident in the cortex passed, on removal of the cortex, to the basal ganglia. In this case there were no basal ganglia, so that some other explanation of the persistence of function is required.

The author then passes on to say that he has always believed in a very rough localization, at least to the extent that there was a difference between the function of the anterior and posterior portions of the forebrain. Whether the functions of the anterior portion of one hemisphere are represented by the corresponding centres of the other side he proposes to test by the removal of these portions on both sides. This brings him to the second head.

If on one side, the frontal lobe be removed from a dog, the disturbance is not severe. It further makes no difference whether the removal is on the right or the left side. If both frontal lobes be removed, the resulting disturbance is far more than a summation of the effects following the removal of the respective lobes in two different animals. The animal so operated upon cannot eat unaided, is unable to use his paws as hands, can walk but in a very clumsy style, and altogether has his capabilities very much reduced.

If, however, the part of the other hemisphere which is removed is not symmetrically placed, but lies in the occipital region, then the result is an animal in which the motor disturbances are not more marked than they were before the second operation. This indicates that the symmetrically placed portions of the frontal lobes have some power of substituting one another. Further than this Goltz refuses to go. A more detailed relation of the parts which substitute one another he cannot find.

In this connection he describes the case of a dog which had the most extensive lesion that he ever saw. In this animal, almost all one hemisphere and the frontal lobe in the other hemisphere had been removed, so that it was only supplied with the occipital portion of the cortex on one side. This dog died two and a half months after the last operation. During life he exhibited very well the symptom of ceaseless activity so characteristic of dogs operated frontally. According to Goltz, he represented a drinking and eating automaton.

In these cases, sensation was slightly reduced, but there was no part of the body without sensation. Despite the possession of the occipital cortex on one side, the dog last mentioned is described as blind, showing that the connections of this region were somewhere severed.

The third heading is on the removal of the occipital lobes. Besides supporting his old view that the removal of the occipital cortex does not necessarily cause blindness, he wishes to show, as against Munk, that it does cause a disturbance of other sensations. Goltz's argument in the case in hand is, that if the removal of the occipital lobes has for its sole effect the production of blindness, then a dog which has lost his occipital lobes should not differ materially from one which had been simply deprived of his eyes. To this end he removed the eyes from two dogs and kept them both under observation for some time; then, selecting the one which appeared the more intelligent, he removed from this animal both occipital lobes.

According to the views of Munk, this further operation was calculated to produce no essential change in the dog already blind. Goltz finds, on the contrary, very distinct changes. They are summarized as follows: The dog which has lost only his eyes avoids obstacles in a room where he is acquainted with the fittings, comes straight to a person when called, easily finds and follows food when it is moved away, is afraid of threatening sounds, will not eat dog's flesh, goes down the steps of a ladder without falling, jumps out of a small pen that comes up to its breast, is distracted by a jet of air blown on the leg, and can walk on a bridge of slats without falling through. The reverse of all these statements is true for the dog which has lost his occipital lobes as well. On the basis of these results he concludes that the view of Munk is incorrect. The paper is full of points of interest which are here passed over. The view of the

entire question of localization is narrow, and Goltz fails to reckon with many groups of facts. For example, while claiming that his view of the structure of the forebrain offers the fullest support to surgical interference with that organ, he is silent as to the means by which the surgeon can localize the tumor which he is about to remove. At the same time, the accounts in the paper are vivid, and we have for the first time a picture of the bearing of dogs with lesions of such extent. The plate contains a photographic reproduction of the four brains discussed, but in all cases the terms right and left in the text are reversed in the plate, the figures being apparently the mirror-pictures of those described.

La concentrazione del sangue come condizione di stimolo del sistema nervoso centrale. J. Novi. Lo Sperimentale, Heft 5, 1887.

Taking his departure from the fact that when the quantity of sodium chloride in the organism undergoes a marked increase, then muscular twitchings followed by clonic and tonic contractions occur, the author presents the results of experiments made on dogs with a view to explaining this fact. The principal results are as follows:

1. When a 10 per cent solution of sodium chloride is injected into the veins it causes cramps in all the muscles so soon as the percentage in the blood has become about twice the normal.

2. Sodium chloride, under these conditions, does not change haemoglobin into methaemoglobin, and therefore acts differently from the alkaline chlorides investigated by Marchand. The blood taken from the animal during the experiment was dark, but on exposure to the air, became light red, and furnished a colorless serum.

3. The cause of the cramps cannot be a direct action of the sodium chloride on the muscles, because a previous injection of curare prevents the contractions, while a subsequent injection of it causes the contractions to cease after they have begun.

4. The action is not one on the peripheral nerves, because when one circulates blood with double the normal quantity of sodium chloride in a sound limb, the contractions do not occur. If when the contractions are most violent, the nerves supplying a limb are cut, they instantly cease. In a dog that had died from the effects of sodium chloride, the peripheral nerves and muscles were still very excitable, while the substance of the brain was not so.

5. The seat of the reaction is in the brain, and there only, so that dogs deeply narcotized with chloroform may be killed by the injection of the sodium chloride without showing any contractions.

6. The loss of water from the brain is the cause of the contractions. The examination of the gray substance of two normal brains, as compared with two from animals which had been treated with sodium chloride, showed from 5 to 6 per cent less water in the latter.

7. The same explanation is probably true for the cramps caused by an analogous but pathological concentration of the blood—those of cholera, for example.

Ueber die Windungen des menschlichen Gehirns. II. *Ueber die Entstehung der Grosshirnwindungen.* A. Richter. Virchow's Archiv, CVIII, 3, S. 398.

In the first part of this investigation the author sought to explain certain abnormal developments in the case of idiots, such as mikro-

gyrie, etc. In this second part he presents the results of his investigations on seven foetal brains. The age is inferred from the length of the longitudinal fissure. This in the smallest specimen was 1.5 cm., and in the largest 5.1 cm. In the younger specimens there appeared, on all parts of the cerebral vesicle, longitudinal and transverse foldings which later disappeared. This disappearance was quite complete in a brain in which the longitudinal fissure was 3.2 cm., and is caused by the distending action of the blood-vessels. The sulcus calloso-marginalis, as well as its prolongations the fiss. parieto-occipitalis and calcarina, arise by pressure from the outside. After the longitudinal fissure has reached a length between from 4.7 to 5.1 cm., invaginations and infoldings of the walls of the hemispheres do not occur, but only secondary sulci develop. These are not due to an excessive growth of the gray matter, but to a retardation of growth along certain lines, with a concomitant development between these lines. The energy of development differs, therefore, in the different parts of the cortex, and this difference is explained as due to the motions of the foetal brain. Each contraction of the heart causes a pulsation of the walls of the hemispheres, and these pulsations, passing as waves on the surface of the brain, have constant lines of interference. Along these lines of interference the development of the ganglion cells is retarded, and so a depression or sulcus is developed. As the brain enlarges, new lines of interference and consequently new sulci are being continually developed. Besides these pulsations, which are one factor, the irregularities in growth and the mechanical action of the skull are both to be taken into account, as stated above.

Das Rindenfeld des Facialis und seine Verbindungen bei Hund und Kaninchen. S. Exner und J. Paneth. Arch. f. d. ges. Phys. XLI, S. 349.

It is found that the cortical centre for the facialis on one side controls the facialis muscles on both sides, and it is therefore suggested that those muscles which are habitually innervated on both sides simultaneously may be controlled from a single cortical centre. The best evidence for this generalization is found in the relations of the facial centre in the rabbit. In this case, the stimulation of the facial centre causes in all cases movements of the muscles of the face on both sides. Cutting under the portion of the cortex stimulated, stopped the contractions on both sides. An attempt was then made to trace the course of the impulse going to the muscles on the same side as that to which the stimulus was applied. The section of all commissures and the extirpation of the facial centre in the other hemisphere did not interfere with the reaction. Longitudinal section of the medulla did, however, stop it. It is inferred from this that the fibres connected with the nucleus on the same side first cross completely somewhere higher up, and that the impulse passes from the opposite to the same side at the level of the nuclei themselves.

Untersuchungen über die feinere Anatomie des Gehirns der Teleostier. R. Fusari. Internat. Monatsschrift für Anatomie u. Physiologie, IV, 7–8, S. 275.

From studying the brain of certain teleosts, the author reaches the conclusion that in general the brains of lower vertebrates do not

differ essentially from those of the higher. He used Golgi's method of staining, and in this paper reports on the cerebellum, valvula cerebelli, and lobus opticus. The two types of nerve fibres and the two of nerve cells as described by Golgi are here found. The neuroglia cells are best distinguished from the nerve cells by the absence of the axis-cylinder process. The epithelial cells surrounding the central canal and its prolongations are conical, with their bases towards the canal, and their conical end is continued into one or more filaments which unite with neuroglia cells, thus indicating the epiblastic origin of the latter. Regarding the differentiation of nerve cells, the author adds that the extraordinary development and profuse branching of the large cells of the outer layer of the cerebellum show how ungrounded the theory is that the higher the animal in the zoological scale, the greater will be the number of prolongations, and the more profuse the branching of homologous nerve cells.

Ueber einen Fall von chronischer progressiver Lähmung der Augenmuskeln. C. Westphal. Opthalmoplegia externa nebst Beschreibung von Ganglienzellengruppen im Bereich des Oculomotorius-kerns. Arch. f. Psychiatrie und Nervenkr. XVIII, 3, S. 846.

In a case of dementia paralytica, with symptoms of tabes and partial atrophy of the left half of the tongue, there was complete paralysis of the muscles of both eyeballs. The pupils did not react to light, but did react on convergence. The post-mortem examination, both macroscopic and microscopic, showed the nuclei and stems of the motor nerves of the eye atrophic. There was, however, dorsad of the atrophic oculomotor nucleus, on both sides, a double group of cells still intact, which, though not described in the adult, have been known as connected with the nucleus of the oculomotor nerve through the experiments of von Gudden on newborn rabbits, and the studies of Edinger and Darkschewitsch on the human foetus. On comparing the specimens with the same region in the normal brain, the groups in question could always be identified in the normal. This group of cells is brought by the author into connection with the iris, which was the only muscle in the eye which in this case remained active, and for this view he advances some indirect evidence, partly physiological and partly anatomical. The failure of the iris to react to light is explained by some break in the sensory portion of the reflex arc.

Die Untersuchungen von Golgi über den feineren Bau des centralen Nervensystems. A. Kölliker. Anat. Anzeiger II, 15, S. 480.

Kölliker upholds Golgi's views regarding the anastomosis of the branched processes from the nerve cells, between which he can never find any union. Though recognizing the two types of cells which Golgi describes, namely, one in which the axis-cylinder gives off few branches and maintains its identity, and the other in which it soon profusely branches, forming a network in which the identity of the axis-cylinder is lost, he refuses to give assent to Golgi's suggestion that the former type may be motor and the latter sensory in function. The axis-cylinder prolongations of the cells of Purkinje do maintain their identity and at the same time give off fine lateral

branches, but it remains to be proved that these cells are motor. A medullated nerve fibre is never seen to break up into branches within the gray matter, though it is always possible that it may become non-medullated and then branch. Kölliker inclines to the hypothesis that the different nerve centres are united by medullated fibres, which arise directly from the finest branches of those nerve cells where the axis-cylinder forms a network in such a manner that either each branch, or several of them together, form the axis cylinder of this medullated fibre.

Studien über den centralen Verlauf der vasomotorischen Nervenbahnen. HELWEG. Arch. f. Psychiatrie XIX, 1, S. 104.

In sections of the cervical cord from insane subjects, where the principal tract of the lateral columns abuts on the anterior nerve roots, the author finds, in carmine preparations, a wedge-shaped mass of fibres which are very fine and intensely stained. Besides this "triangular tract," there are scattered fibres of abnormally small size through other parts of the lateral column, and also in the anterior column. The size is looked on as due to arrested development. The formation has been traced as far cephalad as the commissura posterior and into the lemniscus. Since the abnormally small calibre of the fibres is always associated with a psychosis, and since in all psychoses one system only is invariably affected, namely, the vasomotor, therefore he feels justified in designating this tract as a vasomotor one, and goes on to give the probable terminations of the tract in the cerebral cortex.

Die Temperaturschwankungen des Gehirns in Beziehung zu Gemüthsemotionen. E. TANZI. Originalmittheilung, Centralbl. f. Physiologie, 12 Mai 1888, No. 3.

The description of Tanzi's own experiments is preceded by a succinct account of the investigations in this line by Schiff (1870) and Corso (1881). As regards the single fact of the variations in temperature, the two investigators reach results directly opposed, for while Schiff finds that, in general, the rousing of an emotion is accompanied by a rise of temperature in the brain, Corso finds it to be accompanied by a fall.

Tanzi experimented on six dogs and two monkeys, and sought the answer to the following questions: 1. Whether temperature changes in the cortex followed various stimuli. 2. Supposing such changes to take place, in what hemisphere and in what region of the hemisphere they occurred. 3. The kind of change, whether a rise or fall of temperature. 4. The approximate intensity of the change. 5. In what form do they express themselves subjectively, as a simple sensation, or as an emotion. 6. On what physical or physiological conditions do they depend, the circulation of the blood, or metabolism of brain substance.

For the method of investigation the original should be consulted, but it may be here noticed that the animal was sometimes so arranged that the variations in the cortex and in the lumbar region of the cord could be taken almost simultaneously. As stimuli the following were used: Loud sounds, threats, the odor of meat and urine, stimulation of the vulva, petting; to a bitch her puppies were shown, and to a monkey that had formed the alcohol habit, wine

was offered, and in every case the effect of the idea of release was tried by slightly loosening some of the cords binding the limbs.

The variations in the volume of the brain were also registered, so that any change in the quantity of blood in the cranial cavity was recorded. The conclusions are thus stated: 1. Deep narcosis, great fear or pain place the animal in a condition where no change in the temperature of the cortex follows the stimulus. On, however, relieving any of these conditions, the temperature changes at once appear. Repetition of an adequate stimulus finally fails to cause any thermal reaction. When the cortex does not react, there are still continuous and marked changes in the temperature of the cord. As soon, however, as the temperature changes in the cortex appear, those in the cord become inconspicuous. It is not denied that in the cases where the stimulus fails to produce a thermal change, the excitation does not reach the cortex, but it is maintained that the condition of the cortex is not such that a diffused excitation can take place, and such as is necessary to the development of an emotion.

2. The thermal variation occurs over the entire brain, being localized neither in one part of one hemisphere, nor in one hemisphere alone as distinguished from the other.

3. The changes which have been observed are hardly ever of the nature of a simple rise or fall of temperature, but almost always an alternation of rise with fall, which may continue without much regularity for one or two minutes. The temperature of the cortex is varied thus rhythmically above and below an isotherm which represents the temperature of the cortex in an unexcited condition. The same type of changes was observed in the spinal cord.

4. The variations amounted in some cases to 3° C. above as well as below the normal.

5. These oscillations accord best with the view that one has to do with a diffused emotional condition rather than with a simple localized sensation. The grounds for this view are, the inconstancy of the phenomenon, its duration, its distribution over almost the entire cortex in both hemispheres, the variable intensity according to the psychological conditions, and the intensity which in some cases was attained.

6. That these changes in temperature are independent of variations in the circulation seems probable for the following reasons: The sighing of the animal and the variation in the circulation brought about by stimulating the vagus, cause little thermal variation. The inhalation of amylnitrit causes a rise of temperature in the cortex after some time; but the oscillations, so typical of the other temperature changes, are here wanting. If the volumetric changes in the brain were an index of the changes in the circulation, then there was no connection between changes in the circulation and those of temperature.

It therefore appears as certain, according to Tanzi, that the most various stimuli, in so far as they are capable of arousing emotions, bring about diffused temperature variations in the cortex; these are oscillatory, a rise alternating with a fall; they can be extensive, stand in a close relation to the intensity of the emotions, are independent of the rhythms of the circulation or respiration, and appear, on the contrary, dependent on a rhythmic metabolic activity.

Experiments on Special Sense Localizations in the Cortex Cerebri of the Monkey. E. A. SCHAEFER. Brain, 1888, Jan., p. 362.

The author has continued his experiments which he commenced in company with Horsley. It appears that, contrary to Ferrier's view, the gyrus angularis can be removed without impairing vision. To meet the objection that some of the gray matter was left intact by his method, special care was taken in one case to remove all the gray matter from the sulci. In this animal there appeared at first a hemianopic disturbance, which, however, disappeared in a few days and left vision intact. This hemianopsia Schäfer explains as due to the disturbed circulation in the neighboring lobus occipitalis. On the other hand, Schäfer cannot find the connection between the gyrus angularis and the sensibility and movements of the opposite eye as maintained by Munk.

Further, in opposition to Ferrier, Schäfer was able to obtain movements of the eyes by stimulation of the occipital lobes with weak electric currents. The results of extirpating the occipital lobes on one or both sides accorded with those of Munk. The first produced crossed homonymous hemianopsia, and the second total and persistent blindness without other disturbance. Passing over some points of less general importance, we come to the cases where in six animals a more or less complete extirpation of the gyrus temporalis superior, on both sides, did not cause disturbances of hearing. All six heard well and understood the significance of faint sounds, *e. g.* the footsteps of various people. The removal of both temporal lobes, including the cornu ammonis, and deep lesions in the region of the gyrus temporalis superior, produced at first a condition resembling idiocy, but in both cases it was transient only. One monkey from which a piece 1½ cm. long had been removed from the middle of the gyrus fornicatus, showed at the end of seven months diminished sensibility in the entire opposite half of the body, with exception of the forearm and hand. Previous experiments by Schäfer and Horsley had left it doubtful whether this disturbance was lasting.

Von dem verschiedenen Zustand der Entwickelung der Ganglienzellen bei verschiedenen neugeborenen Thieren. E. BELOW. Two letters addressed by the author to Prof. E. du Bois-Reymond. Verhandl. d. physiolog. Gesellschaft zu Berlin, 3 Februar 1888, No. 7.

These communications represent the continuation of some earlier work by Below, the main conclusion of which is, that if the young of mammals are considered as divided into the helpless and the less helpless at the time of birth, then in the case of the former the ganglion cells in the brain are but partially developed, while in the case of the latter it is found that those in all parts of the brain are fully developed. In general, the development of the cells is first in the medulla, then passes to the cerebellum, next to the midbrain, and so to the cortex. A developed ganglion cell is one in which the nucleus, nucleolus, and the prolongations are clearly formed.

Ueber die Striae acusticae des Menschen. Prof. H. VIRCHOW. Verhandl. d. physiolog. Gesellschaft zu Berlin, 2 März 1888, Nos. 8 and 9.

At a previous meeting of the Berlin Physiological Society, Baginsky had demonstrated and described certain frontal sections through

the medulla oblongata of the cat, made in the region of the posterior root of the auditory nerve (N. cochleae), and in which, among others, there was a very clearly defined bundle of fibres which, in the neighborhood of the tuberculum acusticum, stood in connection with the N. cochleae, then passed on the dorsal and mesial side of the corpus restiforme, and finally bent downwards to the superior olive of the same side. The course of the lateral portion of this bundle is similar to that of the striae acusticae of man, but in its mesial portion it is quite different. In answer to a question whether he had observed in the cat anything analogous to the bundle found in man, Baginsky replied in the negative. This led Virchow to make a presentation of what was known and inferred regarding this bundle. Reviewing the macroscopic course and relations of the striae acusticae in man as given by Henle and others, Virchow takes occasion to remark the need of a careful microscopic examination in these cases, something which is rarely undertaken.

On a series of sections in his possession, which were not made for this purpose, Virchow finds the striae acusticae passing from the N. acusticus as a plain bundle of fibres toward the middle line, and there turning ventrad in the raphe, in such a manner that the raphe is noticeably dilated by the entrance of the bundle. Further it could not be followed.

The rest of the course to the cortex is probably that described by v. Monakow (see abstract, Am. Jour. of Psychology, Vol. I, p. 330), and by Edinger, who finds in the lower vertebrate forms a bundle of fibres which, starting from the interbrain, run toward the medulla, cross in the middle line as fibrae arcuatae internae, and are distributed to the nuclei of the sensory nerves. This central sensory tract of Edinger is considered by him as homologous with the lemniscus in man. The results of these two investigators are thus seen to be fundamentally in harmony with one another.

Ueber die Bedeutung der Hirnfurchung. J. Seitz. Jahrb. f. Psychiatrie, VII, 3, S. 225.

While the physiological demands made on the basal ganglia are fulfilled by the mere enlargement of the mass, it appears, on the other hand, necessary for the cortex to become folded as we ascend in the animal series. The cause of this is the need for better nutrition, so that the sulci are to be looked upon as nutritive clefts. The position of the sulci is characteristic for each species, and is determined by the blood supply, the general form of the brain, and so indirectly by the form of the skull. In those animals with the largest brains, and in man, the variability and substitution among the secondary sulci is very great, while even where there is the most extensive arrest in the development of the human brain, the human type still remains clearly marked. The brain and skull influence one another to some degree in their growth.

Beitrag zur Morphologie und Morphogenese des Gehirnstammes. G. Jelgersma. Uebersetzt von Kurella, Centralbl. f. Nervenheilk. X, 18–20, S. 545.

Jelgersma investigated five idiot brains, among which were two that were pathological in one hemisphere only. From this study he concludes that there are three systems of nervous elements in

the brain and oblongata. 1. The intellectual tracts and centres which atrophy in case of a primary affection of the intellect. 2. Association tracts between the intellectual centres and the reflex arcs, *i. e.* the pyramidal tracts and the lemniscus. 3. The reflex arcs, a continuation of the centres in the cord, *i. e.* the primary centres of the nerves arising in the oblongata, and their connections with one another. The so-called secondary degeneration never passes from the psychical system (1) to the reflex system (3). In consequence of the lesion of one system, another centre of the same system atrophies only when there is connection through the axis cylinder prolongation. Within the same system the ganglion cells also atrophy. The author supports his views by evidence from embryology and comparative anatomy.

Ueber die Schwankungen in der Entwickelung der Gehirngefässe und deren Bedeutung in physiologischer und pathogenetischer Hinsicht. L. Loewenfeld. Arch. f. Psychiatrie und Nervenkr. XVIII, 3, S. 819.

Neither the weight of the brain nor the convoluting of its surface is to be considered as reliable expressions of intellectual development, for they are modified by the length and weight of the body and the thickness of the cortex. To these L. adds another factor, namely, the blood supply considered as the index of the nutrition of the brain. L. compared the section of the basalar carotids and vertebrales, the weight of the brain and the section of the aorta on 200 brains. On the 122 brains which had normal vessels it was plain that within the limits of health there was considerable variation in the section of the basalar vessels, the relative diameter of blood-vessel for each 100 grm. of brain varying between 0.175 and 0.315 cm. The average size of the vessels increases somewhat with age. Between the section of the aorta and that of the basalar vessels there is no constant relation. The capability of continuous exertion and the development of talent depends not only on the other acknowledged factors, but also on the development of the blood-vessels of the brain. It may be added that the carotids were found 12 times alike, and 31 times with the right, 49 times with the left, the larger.

Clinical Lecture on Paralysis of the Fifth Cranial Nerve. D. Ferrier. The Lancet, 1888, No. 3358, p. 1; Gaz. Med. de Paris, 1888, No. 4, p. 37.

The case discussed was an isolated total paralysis of the fifth, on the right side, resulting from an injury to the head. The innervation of the palate remained intact, so that the view of Vulpian, and Beevor and Horsley, that the azygos uvulae and tensor palati have no connection with the fifth, demonstrated on animals, is found true for man. The absence of hyperacusis for high tones, as well as the absence of a subjective sensation of buzzing in the ear, is taken by F. as an indication that the tympanum is not innervated by the fifth. The ophthalmia on the same side F. holds to be neuroparalytic, considering that it is caused by the inflammatory excitation of nerve fibres which are not specifically different from motor, secretory and sensory fibres, and not by separation from a trophic centre. On the two anterior thirds of the tongue the sense of taste

was on the right side wanting, while on the posterior third, on that side, it was apparently reduced. During convalescence the sense of taste and contact returned, while the second branch of the trigeminus was still anaesthesic; and since there were no symptoms due to the injury of the facialis and the glossopharyngeus, F. contests the current view concerning the course of the gustatory fibres, and concludes that the latter pursue either the course designated by Schiff, through the corda tympani, ganglion oticum, the third branch of the fifth, and so to the brain, or never enter the chorda tympani (Bernard), but pass in the third branch of the trigeminus without leaving it.

Les troubles moteurs du cerveau. FR. FRANCK. Extrait d'un livre qui paraitra prochainement à la librarie Doin: Leçons sur les fonctions motrices du cerveau. 1 Vol., 8°. Rev. Scientif. 1887, XXXIX, 25, p. 788. Autoreferat.

The author briefly reviews the results of experimental physiology on this point. He lays much weight on the increase in both the intensity and duration of the phenomena following extirpation as we ascend in the animal scale. In monkeys that gradual recovery is wanting which in dogs takes place to a certain degree. Seeking by clinical-anatomical methods to establish the extent of the motor centres in man, he confines them to the gyri centrales and to the lobulus paracentralis, in this agreeing closely with Nothnagel, who recently investigated the subject by the same methods.

Zur feineren Structur der Nervenfaser. JOSEPH. Verhandl. d. physiolog. Gesellschaft zu Berlin, Jan. 20, 1888, Nos. 5 and 6.

In repeating Kupffer's studies on the fibrillar structure of the axis cylinder in the nerve fibre J. has made use of methods slightly modified from those of Kupffer. In the medullary sheath J. finds a network which he identifies with the neurokeratin framework of Ewald and Kuehne. This framework is not considered as anything preformed, but merely as the expression of a substance other than the myeline which takes its marked form under the action of reagents. All the samples which he has thus far tried have not resisted the action of digesting reagents, and thus fail to agree with the substance described by Ewald and Kuehne. As regards the axis cylinder, he substantiates Kupffer's description of the fibrillae, but takes exception to the designation of the interfibrillar as a nerve serum. J. describes the fibrillae as held in the meshes of a fine network. These studies were largely made on the electric nerves of Torpedo marmorata.

II.—EXPERIMENTAL.

In March last the writer of this note received a clipping from *Science* on "Sound Blindness," with a marginal note from Dr. G. S. Hall, saying: "Can you look into this subject?" Permission to enter the public schools for the purpose was granted by the Boston School Board, and, standing on the teacher's platform, the following words were pronounced, after testing the pitch and loudness of voice by a few words addressed to the master who stood at the opposite side of the room: ultramarine, altruistic, frustrate, ultimatum, ulu-

late, Alcibiades, and unaugmented were the first words used. Time was given between the pronunciation of each for the slowest pupil to write it upon a slip of paper, words being repeated as often as required, some of them having been clearly pronounced five successive times. In the Latin School, 259 boys whose ages range from 12 to 20 years were given this test, 84 of whom made corresponding mistakes in the vowel sounds, their papers showing, *e. g.*, altramarine, ultruistic, frostrate, altimatum, elulate, olulate, alulate, and unolmented. Alcibiades suffered the least, probably on account of familiarity with the name.

At this stage of the investigation, Dr. Clarence Blake, the distinguished aurist of Boston, was consulted, who gave a much better list of test-words, viz., fan, log, long, pen, dog, pod, land, few, and cat. The 84 pupils who confused the vowel sounds in the polysyllables were seated in their various rooms in the front row, while the observer stood at the back of the room, pronouncing these monosyllables but once, the pupils having had notice of this arrangement that they might give instant attention. Only 4 of the 84 spelled all these monosyllables correctly, their papers showing than, thank, fanned, clam, thang, and fam, with several blanks in place of *fan;* glove, clog, lug, love, land, long, knob, for *log;* lung, lown, lone, lawn, lamb, log, loud, and lamp, for *long;* penned, pan, paint, hen, and ten, for *pen;* dove, dug, and dot, for *dog;* hour, heart, hog, hod, hard, fod, thod, fog, bog, pug, part, plot, pard, long, and bog, for *pod;* lamb, lend, lamp, lambed, blend, hen, and can, for *land;* frew, fuse, pew, and pen, for *few;* cat having been understood in every instance. A final and individual test with an aurist's tuning fork was now given the 80 pupils who failed in correct hearing of these words, Dr. Blake kindly supplying the fork (C 562 v. s.) and directing its use; the fork was struck with a rubber-covered hammer, the pupil standing twelve feet away with his back toward the observer. Two cases of deafness were found, but these were known to the teacher, though not to the master. Several doubtful cases appeared which were given the benefit of the doubt, it not being practicable to refer them to a specialist, and the atmosphere of that day being so damp that the instrument gave uncertain sounds.

In the English High School of Boston, 223 boys between the ages of 13 and 18 were tested with the polysyllables, 105 of whom made mistakes corresponding to those already noted. Of the 105, 92 misspelled from one to four of the monosyllables, the errors being in general a repetition of those made in the Latin School in which pupils are received prior to graduation from Grammar School, while all English High School pupils are graduates of grammar departments.

In the Comins Grammar School, 530 pupils between the ages of 8 and 14 were tested with the monosyllables, only 34 of whom spelled all the words correctly. The following tables are based upon the work done in this school, because the opportunities were such as to give fairer results, the same room being used for every pupil tested, and the test words given to classes of 16 only, there being no other pupils in the room and no outside distractions; with the tuning fork first used there were unavoidable variations of weight in the stroke, dependent upon the mental and physical conditions of the observer, and Dr. Blake kindly furnished another, to be differently manipulated. Five children were found who could not hear this tone

twelve feet away, and in neither case had the teachers or master suspected the existence of any disorder of the ear. Two of these were among the brightest in the room, and were seated farthest from their teachers; the others were supposed to be dull and inattentive. After the discovery of deafness, these pupils were particularly observed by their teachers, and the bright ones were found to have the habit of closely watching the face of any one speaking, bending to the right or left during dictation exercises in order not to lose sight of the lips.

For fan, 7 different words and 2 blanks were given, the blanks indicating that the pupil entirely failed to understand the word, and the figures following each word indicating the number of times it was used: than 5; fair 4; thank 3; fell 2; clams, fang, and sam, each once.

For log, 17 words and 10 blanks were given: love 65; flog 3; dog 3; cock 2; long, lo, lack, lawl, lord, lull, lock, lough, loud, lode, glove, bog, and bare, each once.

For long, 14 words and 11 blanks were given: lawn 4; log 3; loan 3; lamb 2; alarm, arm, kong, lung, lant, length, lul, love, lone, and laugh, each once.

For pen, 18 words and 12 blanks were given: hen 48; pan 47; hand 13; ham 5; pain 4; pine 3; pail 3; head 2; paper, paint, pear, pland, can, han, land, ream, ten, and then, each once.

Six words and one blank were given for dog: dug 3; dove 3; dod, dollie, God, and dull, each once.

For pod, 51 words and 64 blanks were given: hog 85; hod 36; pog 26; hard 25; park 10; have 5; fog 6; pond 5; hot 4; cod 4; pug 4; hollow 3; path 3; pot 3; pob 3; pop 3; log 3; pual 3; heart 2; hug 2; prove 2; papa 2; dod 2; long 2; tog 2; hove, hoe, hawk, hoved, hoad, hoge, hart, half, hord, hope, hub, hark, hood, pawd, parg, palm, pant, paw, parm, pok, pout, pard, bong, cot, tod, and of, each once.

For land, 14 words and 12 blanks were given: lamb 42; lion 4; lamp 3; light 2; lank 2; lame 2; lamps, lung, line, light, lend, lampt, lade, and plant, once.

For few, 11 words and 10 blanks were given: flew 4; pew 2; fillt, form, fill, furyon, frew, fug, huge, pill, and pail, once.

Five words and no blanks were given for cat: catch, cans, cap, kept, kait.

The logographic value of letters being modified by those which precede or follow them, the mistakes made will be arranged as they occur in the words given.

F labial, in *fan*, was understood as: c hard palatal 1; s aspirate 1; th lingual 8. A short: e short 2. N lingual: l lingual 1; m labial nasal 1; ms 1; ng 1; nk 1.

Pen.—P labial: c hard palatal 1; l lingual 1; r liquid 1; t lingual 1; h aspirate 69. E short: e long 1; i short 2; i long 3; a long 9; a short 69. N liquid: t lingual 1; r liquid 2; l liquid 1; m labial nasal 6; d lingual 17.

Land.—L liquid: pl 2. A short: u short 1; e short 1; a long 3; i long 8. N liquid: ng 1; m labial nasal 49. D lingual: k palatal 2; p labial 4; t lingual 6; escaping the ear entirely, as in lion, line, etc., 4.

Dog.—D lingual: g palatal 1. O short: u short 7. G palatal: v labio-dental 1; l liquid 2; d lingual 2.

Log.—L liquid: gl 1; fl 3; c palatal hard 2; b labial 2; d lingual 4. O short: a broad 1; ou 1; a short 2; o long 2; u short 68. G palatal: l liquid 2; d lingual 3; k palatal 4; v labio-dental 66.

Long.—L liquid: al 1; ar 1; gl 2; k palatal 1. O short: u short 1; e short 1; a medial 2; a short 3; a broad 5; o long 5. Ng: f labio-dental 1; l liquid 1; t dental 1; v labio-dental 1; g palatal 3; n liquid 7; th added 1.

Pod.—P labial: b labial 1; d lingual 2; c hard 5; f labio-dental 6; t aspirate 6; l liquid 7; h aspirate 171; no consonant before o once. O short: oo in hood 1; ou in pout 1; u long 3; o long 6; u short 7; a broad 7; a short 12. D lingual: g soft 1; f labio-dental 1; m liquid 2; th 3; p labial 3; b labial 4; ng 4; l liquid 5; v labio-dental 7; k palatal 13; t dental 17; g hard 132; open vowel 6.

Few.—F labio-dental: h aspirate 1; p labial 4. Ew: a long 1; o short 1; u short 2; i short 3; vowel sound preceded by l liquid 1, and by r 1; succeeded by g hard 1, by g soft 1, and by l 4.

Cat.—C palatal: h aspirate 1. A short: e short 1. T dental: p labial 1; ns 1; preceded by p 1, and succeeded by ch 1.

For courtesy extended by the teachers, whose routine work was somewhat interrupted, especial thanks are due, also to Dr. Merrill, head-master of the Boston Latin School, Mr. Pritchard of the Comins Grammar School, and the subordinates in all the schools entered; while the attention and ready obedience to directions of the pupils made the work a pleasure. Nothing could have been accomplished without the consent of the School Board, and the ready coöperation of that body is gratefully acknowledged.

As a matter of course, such tests lack mathematical accuracy, but great pains was taken, and much private practice made the pronunciation as nearly exact and even as it would be likely to be under any circumstances. The work was experimental, the path unbroken; better methods will undoubtedly be devised and more surprising results obtained.

One circumstance is not without suggestiveness. A child seven years old, with peculiarly abnormal development, was pronounced feeble-minded by examining physicians, but was retained in the kindergarten, where it received especial attention and made marked improvement. Dr. Blake kindly examined the child and found that early trouble with the inner ear had occasioned a period of deafness which had arrested mental development. The child is to be sent to the School for Deaf Mutes to learn the use of his vocal organs, instead of the School for Feeble-minded Children, the ear meanwhile to receive such treatment as the disorder indicates.

SARA E. WILTSE.

Sulla riproduzione degli Organi Gustatorii. LUIGI GRIFFINI. Rendiconti Reale Istituto Lombardo, Ser. II, Vol. XX, 1887, pp. 667–683, 2 tavole.

Dr. Luigi Griffini, of Modena, has quite lately published (*Rendiconti del Reale Istituto Lombardo*, XX, 1887) an interesting memoir containing the results of his experimental study of the reproduction of the gustatory papillae and regeneration of the taste-bulbs in the rabbit and dog. It appears from his experiments that destruction (partial or complete) of the organs of taste is effected in two ways: first, by direct removal from the animal of the papillae themselves;

and secondly, by division of the glosso-pharyngeal nerves. After excision of the whole or a part of a papilla foliata of the rabbit, the area corresponding to the part removed becomes slightly depressed, and between the 5th and 8th day is revested with pavement epithelium. Later, from the 16th to the 20th day, a few small hemispherical elevations make their appearance, and these subsequently increase in size and number. During this period also many of the injured gland ducts undergo repair and become continuous with the free surface of the epithelium. Other ducts are found in the submucosa with their external opening closed, and greatly dilated by retained glandular secretion. The nuclei of the cells of the newly formed epithelium, both of the papilla and ducts, exhibit varied karyokinetic phases. Within the secondary papillary processes of the elevations above referred to, taste-bulbs, lying partly in the mucosa (and in process of formation), first make their appearance. Ten days after the complete excision of a papilla circumvallata of the dog, the area of removal is reclothed with epithelium, and the ducts communicate with the free surface. Twenty to thirty days later, a slightly raised and more or less rounded elevation of the mucosa is discernible, analogous to the reproduced elevations of the foliate organ. At the 40th day (in a single instance only) a few taste-bulbs, situated at the lateral margin of an elevation, were seen. The outer enclosing wall of the trench is not reproduced, the newly formed papilla having the characters of the fungiform type. Following section of the glosso-pharyngeals, the papillae are changed but slightly, but the taste-bulbs begin to degenerate within 23 hours. The taste-cells are first destroyed, disappearing completely by the 5th day; the supporting cells soon after undergo atrophy, and by the 28th day no bulbs are visible. At the 76th day after the division of the nerves, bulbs, in various stages of formation, were seen; but by the 209th day their development was still incomplete. Griffini rejects the theory of direct continuity between nerve-fibres and epithelial cells. He asserts that reproduction of the papillae after their partial or complete removal always takes place. The reproduction of the taste-bulbs, following the removal of a papilla or after section of the glosso-pharyngeal nerve, is effected in the following way: The axis cylinders of the divided nucleated nerve-fibres are regenerated and penetrate the epithelium; active prolification of the adjacent epithelial cells then occurs, the latter arranging themselves around the interepithelial nerve-fibrils and forming the supporting cells of the bulbs. This research of Griffini, although still incomplete, is a valuable contribution, not only to our knowledge of the taste organs, but also from its bearing upon certain histogenetic and morphological questions. The results attained by him, respecting the origin of the taste-bulbs, are in the main very different from those reached by such observers as Ranvier, v. Vintschgau and Hönigschmied. Griffini has likewise made a similar experimental study of the organ of smell, the motorial end-plate of the muscle-fibre, and the retina of the lower animals, the results of which have not yet, I believe, been published. F. TUCKERMAN.

Eine Vorrichtung zur Farbenmischung, zur Diagnose der Farbenblindheit und zur Untersuchung der Contrasterscheinungen. E. HERING. Pflüger's Archiv, Vol. 42, p. 119.

This plan of Hering's for color experiments has the merit of great simplicity. A dark room is provided with a rectangular hole in

a window-shutter in which two frames, which can be filled with different colored glasses, move up and down. The frames are only three-sided, so that the adjacent edges of the pieces of glass may be exactly contiguous. If one frame contains blue glass and the other the complementary yellow, a sheet of paper thus lighted up will appear white. It is, of course, necessary that a line drawn from any point of the paper to every point of the glass should, when produced, strike the evenly illuminated sky; to this end the window must face the north, or else the room can only be used on a cloudy day. Since exactly complementary colored glasses are not easily to be obtained, it will usually be necessary to take three colors to make white light; thus if a given blue and yellow make a greenish white, then half of one frame (which is twice as long as the opening) should be fitted with red glass, and enough of the red should be shoved in to make the paper exactly white. An exact white cannot of course be distinguished from a pale color unless part of the paper is lighted up by white light from another opening and protected from the colored rays. To get the blackest possible background, the paper may be suspended across a larger hole which looks into a black-lined box.

To test for color-blindness, a rod is put up at such a distance from the window that (if the glasses are red and white) the red and the subjectively green shadows are side by side on a paper just big enough to receive them. By cutting off some of the white light by means of a pasteboard slide, the two shadows are made of the same degree of brightness, and to any one who is completely red-blind they will look exactly alike,—it makes no difference what color he pronounces them to be. The copper-red glass of commerce will usually need to have a little blue mixed with it to produce the color which he is completely blind to.

The advantage which Hering claims for this plan over that of rotating disks, aside from its simplicity, is the greater constancy of the colors that are produced; paper varies more in color than glass, and its color changes more with different degrees of illumination. The plan is particularly well adapted to experiments in contrast. The subjective color is extremely vivid and beautiful, sometimes even surpassing the objective color. The chief objection to Hering's view that simultaneous contrast is a physiological effect and not a mere illusion of the judgment, is that the contrast is not greater with a greater intensity of the inducing field. But Hering says that with this arrangement the contrast *is* greater. He first puts up a red glass and a colorless glass with a shadow-casting rod in front of them, and then he covers the colorless glass with sheets of tissue paper until the contrast green reaches a maximum. He then draws out the red glass and pushes it back gradually; as he does so, the contrast green grows stronger and stronger. It seems to us that the reasoning here is not quite conclusive. It is merely shown that the degree of grayness which suits a certain degree of redness best, is in turn best suited by that particular degree of redness. In other words, choose, out of all possible graynesses, the one that gives the best effect of contrast with a certain redness, then no other redness will give so good an effect of contrast with that particular grayness. It is not shown that a more saturated green would not be produced with a different redness and a different grayness (though experiments which he has not described may have enabled him to infer

this); one cannot help being on the lookout for that "favorable difference," independent of absolute color or brightness, which Neiglick has shown the existence of in brightness contrast.

C. L. F.

Ueber die Ursachen der Erythropsie. DOBROWOLSKY. Archiv für Ophthalmologie, Vol. 33, 2, p. 213.

After the performance of certain operations upon the eye, the patient sometimes sees everything violet, rose-colored or reddish, or in some cases of a bright red, even a blood-red, color. Occasionally darker objects look green. The affection lasts sometimes for a few minutes, sometimes for days; since its first accurate description in 1881, over thirty cases have been noted. Dobrowolsky has confirmed by experiment the hypothesis that it is due to an after-image of some bright object, as the edge of the sun or a bright cloud. He widened the pupil of one eye by atropin, and then found that after looking at a bright cloud near the sun, or the edge of the sun itself, all white objects in a room looked violet. This violet color lasted sometimes for a quarter of an hour, and it was succeeded by a state of excitation of the retina, during which, for an hour, all objects looked yellow, orange, or carmine-red. With the other eye, the pupil of which was kept narrow for purposes of comparison, a sharp, distinct after-image of the sun was obtained which was bright blue in the middle and violet on the edge. The widening of the pupil is then, under ordinary circumstances, a necessary condition for the production of the phenomenon. Violet-vision would be a better name for it than red-vision; it might be expected to occur more frequently were it not that the eyes are usually protected from a bright light when they are in a condition favorable to bringing it on.

(1) *Ueber die Zeit der Erkennung und Benennung von Schriftzeichen, Bildern und Farben.* JAMES MCKEEN CATTELL. Wundt's Philos. Studien, II (1885), pp. 635–650. Also in abstract by the author, Mind, XI (1886), pp. 63–65.

(2) *Ueber die Trägheit der Netzhaut und des Sehcentrums.* JAMES MCKEEN CATTELL. Wundt's Philos. Studien, III (1885), 1, pp. 94–127. Also, slightly abbreviated, Brain, Vol. VIII, pp. 295–312.

(3) *The Influence of the Intensity of the Stimulus on the Length of the Reaction Time.* JAMES MCKEEN CATTELL. Brain, Vol. VIII, p. 512.

(1) In the time measurements of which this study consists, complicated apparatus was avoided. For the first series, a kymograph drum was covered with white paper, on which the letters, pictures, or colored spots to be shown, were pasted. Between the drum and the subject was a screen, and in it a horizontal slit of adjustable length, through which the letters, etc., were to be viewed. The letters were so spaced that when the slit was 1 cm. long, the second letter was brought into view as the first disappeared; when the slit was 2 cm. long, two letters were constantly in the field, and so on. The following are the average times from nine subjects:

Length of slit in mm.........	1	2.5	5	10	20	30	40	50	60
Time in thousandths of a sec.,	499	356	292	248	225	209	202	198	198

From this it appears that about 0.25 s. was required for each letter when the slit was 10 mm. long and one letter at a time could be

seen. This, however, does not fully represent the time needed to recognize and name a letter, because the name of the first letter was being automatically pronounced at the time that the second letter was coming into recognition ; the full process is about 0.1 s. longer. When the slit was still longer, the overlapping process was extended, and while the first was being recognized, several letters were going through the preliminary stages. Some subjects were assisted by having as many as five letters in the field at once. When the slit was shortened instead of lengthened, the times are longer ; greater concentration of the attention was necessary, and the overlapping process did not take place so readily. Counting letters or dots took longer than naming the letters, but was shortened if they were grouped by twos, or better still, by threes.

In the second series the subjects read connected and unconnected letters and words, and the time for a fixed number was taken with a pocket chronometer. Reading as fast as possible, it took about twice as long to read unconnected words as connected ones, that is, about 0.25 s. per word, which is about the same as for *ordinary* reading of connected words. The reading of connected letters and words seems to be facilitated by an overlapping of processes like that in the first series. Disconnected letters were read a little faster than disconnected words, and Latin faster than German letters. The time per word for 100 connected words, read as rapidly as possible, was for Dr. Cattell himself: English 0.138 s., French 0.167, German 0.250, Italian 0.327, Latin 0.434, Greek 0.484, following the order of his familiarity with those languages. It took about twice as long to name colors and pictures as words and letters, the extra time seeming to be spent in hunting for their names, which in the case of letters and words come of themselves.

(2) With the inertia which continues sensation every one is familiar in the form of after-images, but that which hinders its beginning is not of common observation and has been little studied. It is the time required for the overcoming of this latter kind of inertia that the author has measured. The instrument used was the gravity chronometer, which is essentially a device for letting a screen with a horizontal slit in it, fall in front of the object that is to give the stimulus. Before and after the fall the object is hidden ; it is seen while the slit passes over it. A slit 1.3 mm. wide corresponded in these experiments to 0.001 s. The objects were colored surfaces, letters, and German and English words. The illumination was lamplight or that of the clear sky. The colors were red (rather dark), orange, yellow, green, blue, and violet (slightly red). In showing these by means of the chronometer, a length of time was found at which each could be distinguished from a corresponding shade of gray, about nine times in ten. Seven subjects with sky illumination gave average times as follows, the unit being 0.001 s. : red 1.28, orange 0.82, yellow 0.96, green 1.42, blue 1.21, violet 2.32 ; the shortest of all being 0.6 for orange and yellow, and the longest, 2.75 for violet. When the first stimulus was followed immediately by a second (white, orange, and blue were tried), the times required for the first to produce its sensation were longer. With lamplight the times were also longer, and the order of quickness changed. The five grades of lamplight tried seem to justify the generalization that "the time colored light must work on the retina in order that it may be seen increases in arithmetrical progression as the intensity of

the light decreases in geometrical progression." The length of time for letters and words differs with the size and kind of type (Latin or German), and for words with their length. Letters and words in type of the size of the body of this magazine were read correctly half the time at from 0.001 s. to 0.0017 s. The time for words was in some cases even shorter than for letters. As before, the effect of an immediately following stimulus was to lengthen the time needed for seeing the letter or the word, but if it did not follow within 0.005 s. its effect was reduced. The times needed to see colors and letters represent not only the inertia of the retina, but also that of the brain; at least it may be supposed that stimuli acting on the retina for a less time do produce some effect, which, however, does not reach consciousness.

Some experiments were also made on the grasp of consciousness. Sets of from four to fifteen short perpendicular lines were shown for 0.01 s. Of the eight persons tried, two could give correctly the number seen up to six, two up to five, three up to four, and one not so many. Tried in this way, groups of letters are harder to grasp than groups of figures, because no combination of figures has a wholly strange look. A smaller number of words could be read than single letters; only half as many disconnected as connected words; and only one third as many disconnected letters as letters in words. In these experiments, especially in the last group, the individual differences of the subjects were considerable.

(3) Dr. Cattell's experiments extended only to variations in the intensity of light and induction shocks. Six grades of light were made by putting smoked glass before a Geissler tube, corresponding respectively to 315, 123, 23, 7 and 1 when the full light was counted as 1000. Two grades of higher intensity were made by putting lenses before the tube, but their relative intensity could not be fixed. On the basis of 150 reactions on each, reaction times were found varying for B. from 0.308 s. with the faintest light, to 0.168 s. with the brighest, and for C. from 0.251 s. to 0.128 s.; to these, however, the author does not attach an absolute accuracy, the important point being their relation. The decline took place with every increase of intensity, except once for B. Four grades of electrical stimulation were reacted to in times from 0.182 s. to 0.158 s. for B. and 0.164 s. to 0.131 s. for C., the decline being as before, including the exception of one for B., where perhaps the very violence of the stimulus caused a retardation of the reaction. On continuing the experiments to more complicated processes with grades of light corresponding to 315, 23, and 1, the experimenters found (giving the figures in the order of intensities from the greatest down) as follows:

Perception time, B. 0.049 s., 0.075 s., 0.100 s.; C. 0.085 s., 0.119 s., 0.114 s.

Will time, B. 0.049 s., 0.027 s., 0.020 s.; C. 0.082 s., 0.060 s., 0.078 s.

The Effect of Pure Alcohol on the Reaction Time, with a Description of a New Chronoscope. Joseph W. Warren, M.D. Journal of Physiology, Vol. VIII, No. 6.

It must have been disappointing to the experimenter, as it certainly is to the reader, that this fully reported study should have led to such insignificant results. After more than eight thousand reaction-times taken, the conclusions are scarcely more than probabili-

ties, among which these seem to be the best supported, namely, that alcohol favors change of the average reaction time from its normal amount, and that there seems to be no constant and direct connection between the reaction time, either "in quantity or in quality," and the taking of alcohol. These experiments were made before attention had been called to the distinction between what Wundt calls motor and sensory reactions, that is, between those that are automatic and those (distinctly slower) that are accompanied by full psychic processes. The figures found for the normal reactions, from 0.1398 s. to 0.2001 s., would mark them as of the intermediate or mixed class from which uncertain results are apt to follow. The action of the stimulant in inclining the subject toward the motor or sensory form of reaction is not known; it may differ from subject to subject, or even with the same subject at different times. Absolutely irreproachable experiments on reaction-times are not easy to carry out, and certain conditions of experiment perhaps have been too little regarded in these.

The new chronoscope described is an improved form of the Exner Neuramœbimeter (Psychodometer of Obersteiner) designed by Prof. H. P. Bowditch. In both instruments the time measurement depends on tuning-fork vibrations; in the earlier one the fork carried the writing point, and a smoked plate was moved beneath it; in the new one the fork carries a smoked card and is drawn backward; the writing point is fixed, except as its movements are controlled by an electro-magnet. A chief advantage of the new instrument is that the subject of experiment can be placed at a distance and out of the range of any disturbing noise from it.

Experiments on Tetanus and the Velocity of the Contraction Wave in Striated Muscle. John P. Campbell. Studies from the Biol. Lab. J. H. U., Vol. IV, No. 3.

The muscles experimented on were the neck retractors of the terrapin, their length and character making them unusually appropriate for such work. The author set himself to determine, first, the least number of stimuli per second required for tetanus, and second, the rate of transit of the wave of contraction. The curarized muscle at 4° C. loaded with about 8 gr. and stimulated by an induction shock once per second, showed tetanus; at 9° five shocks were required, at 21° twenty-five, and at 28° thirty-four. The curarized gastrocnemius of a frog at 25½° required thirty-seven stimuli per second, ten more than the highest figure before given; a difference due, in the opinion of the author, to the sensitiveness of the apparatus used. The character of the muscle itself is also a factor; its influence is thus generalized: "the more extensible a muscle is, the fewer stimuli per second will suffice to tetanize it." In varying the strength of the stimuli, it was found that those which singly were too slight to produce contraction might result in tetanus if repeated with sufficient rapidity. The rate of propagation was found to be from 2 m. to 2.62 m. per second, with a rapid decline through fatigue (and an increase with increase of load). As regards the direction and rate of stimulation between the electrodes, the experimenter found that, except when very strong, it starts from the cathode and goes toward the anode at a rate much greater than elsewhere in the muscle, as high in fact as 13 m. per second. Some of

the apparatus used was of improved form originating with the author.

The Reinforcement and Inhibition of the Knee-jerk. H. P. BOWDITCH, M. D. Boston Med. and Surg. Journal, May 31, 1888.

The interesting experiments of which this paper is a preliminary report, had for their object the study of the effect of time upon the reinforcement of the knee-jerk. They start from the well known fact that the knee-jerk is for a time reinforced when preceded by other muscular action. The subject, having taken his position, and been connected with the recording apparatus, at a bell signal, gripped a piece of wood with his right hand. The bell signal was followed at from zero to 1.7 seconds by a regulated blow on the patellar ligament producing the jerk. The experiments were made in courses of about an hour, each embracing several series. Each series was begun by a number of simple knee-jerks, to be used as a basis of comparison with the reinforced ones that followed. The difference between the averages of these parts of a single series was known as the *special* reinforcement; that between the second part of any series and the average of all the first parts of the same course was the *general* reinforcement. In the cut which represents graphically the results of 551 normal and 624 reinforced records on four subjects, the curves for the special and general reinforcements follow nearly the same course. If the hammer stroke was less than 0.4 sec. later than the signal for clinching the hand, the extent of the knee-jerk was increased; if it was more than 0.4 sec. later, the extent was less than normal, till at about 1.7 sec. it again became normal; that is to say, by a clinching of the hand, the spinal centres for the knee-jerk are first excited, then depressed, and then gradually return to their normal condition. Says Professor Bowditch: "We have in this alternating action a phenomenon which cannot fail to throw light upon the nature of 'inhibition,' and [is] destined perhaps, when fully understood, to establish the interference theory on a firm basis."

Ueber die Wahrnehmung der Geräusche. ERNST BRÜCKE. Wien. Sitzb. 3te Abth., XC (1884), pp. 199–230.

On the ground of certain experiments, Exner published the conclusion, in 1876, that we hear tones and noise with the same organs. The present paper is a further study of the same question, made by the author in connection with Profs. Exner and Fleischl. If this conclusion is true, and both are perceived with the same structure of the ear, they should show points of similarity. And such they do, both in common experience (witness the representation of cannonading by drum strokes), and in suitable experiments more clearly still. Experiments were begun on explosive noises as the simplest. Having adapted a flame and rotating mirror to the study of such sound waves, the author first tried the report given in forcing a rubber stopper out of lead tubes of various lengths by compressed air, which proved to be a series of waves of decreasing intensity; and later, the explosion of soap-bubbles of hydrogen and air, which gave a solitary wave. Discriminations of high and low could be made with both, corresponding with the length of the tube and the size of the bubble, as should be the case if the noises are heard with

the tonal apparatus of the ear. It was further proved that a series of short and sharp sounds like those of a watchman's rattle, provided all extra accompanying sounds were fully damped, could be as rapid as 600 or more per second before producing an even tone. The corresponding parts of the ear leap into vibration at the first impulse, and as quickly subside. This makes possible a wide range of untonal sensations. If tone arises from continuous, even, and regular stimulation, noise arises from short, irregular and suddenly varying stimulation; and the two classes of sound pass into one another by insensible gradations. The complex noises, rustling, hissing, blowing, etc., can be reduced to noises as simple as those tested, differently combined, varied in quality, intensity and rapidity, and accompanied in differing degree by true tone. These experiments do not exclude the possibility of special organs for noise-hearing, but they seem to make their assumption, which is attended with difficulties, unnecessary.

Ein Kinesiæsthesiometer, nebst einigen Bemerkungen über den Muskelsinn. E. Hitzig. Neurol. Centralblatt, May 1 and 15, 1888.

The kinesiæsthesiometer, less formidable than its name might suggest, is a set of 17 wooden balls for testing "muscle-sense." The balls are about 7 cm. in diameter, and graded from 50 to 100 grs. by 10's, from 100 to 300 by 50's, and from 300 to 1000 by 100's. For use with the lower extremities, a stocking is provided with a pocket at the heel for the reception of the balls, the patient lying on his back during the experiment. The advantages of this device over others mentioned by the author consist in its easy and speedy application and in its portability. Previous measurements of the fineness of discrimination are discussed, and one tenth, the smallest difference for which this apparatus is adjusted, is taken as about the limit of sure discrimination with the upper extremities for normal subjects, and thus as an appropriate starting point for testing those whose sensibility is blunted by disease. For the lower extremities the limit is one tenth or more.

A large portion of the paper is taken up with a discussion of what is really measured in tests of this kind, and particularly of the hypothesis of a special central *Kraftsinn*. The author is not opposed to such an hypothesis—in fact, does not see how voluntary motion is to be explained without it—but at the same time does not believe that it is necessarily a conscious sensation, nor independent of the centripetal sensations from muscle, skin, and joint. He adds an interesting critique of arguments pro and con, together with three cases from which such a sense might hastily be deduced, but which on closer examination are inconclusive. In such experiments he considers one measures the sensations of movement in the most general meaning of the word, hence the name of his instrument.

Grundlinien zur Erforschung des Helligkeits- und Farbensinnes der Tiere. Vitus Graber. Prag, Temsky; Leipzig, Freytag. 1884, pp. 332.

The question of the color-sense of animals has been put into a new stage of development by the admirable experimental work of Vitus Graber. His investigation has hardly received the attention which it deserves, and it seems worth while to give a summary of his results, although they are already four years old.

In studying the function of the eye in animals, it would seem to be self-evident that the color-sense ought to be sharply distinguished from the brightness-sense. If an animal is merely given the run of several different colored boxes, he has no means of knowing whether his experimenter wishes him to choose a resting place on the ground of color or of brightness; he may prefer a dark blue box to a bright red one, although with equal brightness, his choice would be for red rather than blue. It is absolutely necessary to eliminate the question of brightness before attacking the question of color, and this, strange as it may seem, has hitherto not usually been done. What is still stranger, both of the erroneous conclusions that are possible in the case have actually deen drawn.

The first experiments on the color-sense of animals were made by Paul Bert in 1869, on daphnids. These little animals strongly preferred the yellow-green to the other portions of the spectrum, and M. Bert had no hesitation in concluding that they did so on account of its greater brightness; he even infers, what is still worse, that "throughout the whole visual region, the difference of brightness of the different colored rays is the same for them as for us." On the other hand, Lubbock's experiments on bees, ants and wasps, though exceedingly painstaking in other respects, were not sufficiently controlled by other experiments on the brightness-sense of these little animals. Mereschkowsky (Compt. Rend. I, 93, p. 1160) distinguished between the two kinds of sensitiveness, but from the fact that certain low crustaceans did not react to differences of color, he inferred that they are not able to distinguish colors. Experiments of this kind, as Graber points out, can give only positive results, not negative ones. If the greater portion of the animals experimented upon leave the blue box for the red one (the brightness being equal), then the fact that they *prefer* red proves that they can *distinguish* red; if they distribute themselves equally, it is merely shown that they do not, under the given circumstances, prefer one color to the other, not that they are incapable of distinguishing between them.

Graber's experiments were conducted with very great care, and his conclusions are also, for the most part, unexceptionable. He experimented on about fifty different animals. He preferred to offer his animals the choice of two boxes only at a time; he rightly considered that to ask them to bear in mind and to choose between four different colors at once is to put too great a strain upon their mental powers. Each species was tested first for its preference in regard to brightness and darkness. Colored lights were obtained by means of glasses and solutions (fifty-eight in number), all carefully tested for their color by means of Zeiss' micro-spectroscope, and for their brightness by a Rumford photometer. On account of the difficulty of obtaining different colors of equal brightness, the animals were usually offered first a choice, say between a brighter red and a darker blue and then between a darker red and a brighter blue. If, as they often did, they chose the same color in both cases, this of course plainly showed a strong preference for that color, irrespective of brightness. The caterpillars of *Vanessa urticae*, for instance, chose a bright blue rather than a dark red chamber in the proportion of 196 to 66; but they also preferred a dark blue to a bright red one in the proportion of 193 to 81, in spite of the fact that in colorless chambers they preferred light to darkness in the ratio of ten to one.

Graber's results are extremely interesting. They establish beyond

doubt the existence of a very widely distributed color-sense among animals; of the fifty animals experimented upon, no less than forty showed strong color preferences. There is, of course, no reason to suppose that those which did not react to color differences are insensitive to color, but merely that they are indifferent to colored resting places; they include highly developed animals, as the cat, the guinea-pig, the rabbit, the dove, the hen, the parrot and the turtle. A sensitiveness to ultra-violet light, which Lubbock established for ants and daphnids, Graber finds to be very common—nearly all of the twenty animals which he examined in this respect exhibited it. The bullfinch (*Pyrrhula vulgaris*), for example, showed a preference coefficient of 2.5 for blue with ultra-violet over blue without ultra-violet. Chrysomela, which loved darkness, and had a strong preference for red over every other color, was absolutely indifferent (190 : 194) to red and black, while it distinguished between white with and without ultra-violet with the instances 72 and 154 respectively. In general, animals which love the dark are red lovers, and those which love the light are blue lovers, but this is not a rule without exceptions, and Graber considers that no adequate explanation can at present be given of it. The strength of the preference between red and blue is greater than that between any two colors that are nearer together in the spectrum.

But the most interesting results were obtained with eyeless and blinded animals. The common worm was known before to be sensitive to light, but it was believed by Hofmeister and Darwin that it was sensitive only at the cerebral end. Graber obtained for it a preference of five to one for black over white when whole, and of three to one when, in order to be sure of getting the right end, 7 mm. in length had been cut off from both ends. In this amputated condition its preference for red over blue (3 to 1) was nearly as great as when uninjured. The animals selected for blinding were the triton and the cockroach. In the case of the former, the eyes were removed, the holes filled up with wax and the whole head covered with a thick cap of the same material. (In this condition, and without food, they lived and remained active for months.) Of 2102 trials, there were 674 cases of seeking the bright compartment, and 1428 of seeking the dark one; the preference for green over blue was 5 to 3, for red over green it was 2 to 1, and for white without over white with ultra-violet it was 5 to 2. Control-experiments were made in this case as in others, to exclude the effects of heat, though there was no sensible difference of temperature between the two compartments. The cockroach had the antennae removed and the head covered with a thick coating of black wax. It gave a preference coefficient of 2.3 for black over white, and of 1.7 for red over blue; the corresponding numbers for the normal animal were 7 and 5. It could even distinguish plainly between rather slight differences of brightness. Herr Graber admits that though he was already accustomed to surprises, these last results threw him into a state of actual excitement. He is of the opinion that the animal is induced to go into one compartment rather than another by means of a special skin sensation, and not of a mere change in the carbonic acid production, though that is known to be affected by a difference in color of light; the motion is so rapid and energetic that he thinks there is not time for it to be caused by a feeling of lack of breath. Moreover, such low animals as snails, when their eyes have been destroyed, quickly

develop new ones out of depressions in the skin. One is reminded of the experiments of Fontan, in which a hypnotic subject readily sorted with his hands colored wools which it was impossible for him to see, though these are, of course, far too extraordinary to be accepted from a single instance.

Several questions which have been hotly discussed would seem to be definitely disposed of by Graber's experiments. (*a*) It is plainly established that animals have a color sense. Grant Allen affirmed that it is very rarely that animals react to differences of color, which shows, as our author remarks, the danger of investigating nature after a purely speculative fashion. (*b*) Do colors look the same to animals as to us? To those which are sensitive to ultra-violet, and to those, if there are such, which are insensitive to red, they evidently do not; white, and every other color which is not of spectral purity, must look different to them. As regards others, there was never any ground for discussing the question; there is no possibility of answering it one way or the other. (*c*) Magnus and others have said that certain animals which have no cones in the retina must be for that reason insensitive to colors. It is now plain that the color effect must be due not to any particular morphological structure, but to the presence of certain chemical substances decomposable by light. (*d*) The existence of colored flowers and fruits is certainly not essential to the development of a color sense. It is not even true that flower-loving animals have a more highly developed color-sense than others; the flea which infests the dog reacts to much finer color-differences than the bee. (*e*) The theory that the men of Homer's time had any difficulty in distinguishing colors will have received, it is to be hoped, its deathblow.

We have only two criticisms to make upon Graber's work. He does not give sufficient importance to the fact that the choice which his animals exhibit is choice of a *place of abode*, and that they might have different color-preferences for small objects. He does not seem to have offered his animals the choice between green and blue without ultra-violet: with blue with ultra-violet and green, they gave very marked reactions. C. L. F.

Some Observations on the Mental Powers of Spiders. George W. and Elizabeth G. Packham. pp. 36. Reprinted from the Journal of Morphology, Vol. I, No. 2, December, 1887.

These entertaining experiments upon the mental powers of spiders extended to the sense of smell, their hearing, maternal emotions, sight, color-sense, feigning death, and their mistakes. The experiments on the sense of smell were conducted as follows. A glass rod dipped in an odorous liquid was held near the insect, and its motions observed. These experiments were checked by offering the clean rod under the same circumstances. The odors used were essential oils, cologne, and other such perfumes. In 220 experiments on a number of species, but three species were found that did not respond. The responses were "by various movements of legs, palpi, and abdomen, by shaking their web, by running away, by seizing the rod and binding it up with web as they would an insect . . . . by approaching the rod with the first legs and palpi held erect." To loud noises most spiders gave no sign, though one, when on the finger, jumped when "bang" was shouted, and erected its head

when whistled at. Many more responded to tuning-forks. At the first approach some kinds dropped downward a distance from their webs, but seemed after a time to learn to disregard the fork ; though they soon forgot. Removal of the palpi and several of the legs did not long interfere with their reactions. These tests failed with spiders that make no web ; because of a difference in habits, it is suggested. Still it might be queried whether the perception of the impulses of the air by touch, or from the co-vibrations of the web, were not what was really tested, and had something to do with the difference between the web-making spiders and the others. The impulses of the air from a large tuning-fork can be distinctly felt on the hand. The maternal instinct was studied in the readiness with which females of the species that carry their egg-sacks attached to themselves, would reaccept them after they had once been removed. Most failed to remember them for 48 hours, some for 24. A spider of another species, however, resumed the care of her eggs after being away from them and her web for 51 hours. The sense of sight was tested with cocoons also, and led to the very interesting result that spiders that are used to seeing their cocoons, recognize them at a distance of several inches, while those that carry them attached to their own bodies and so know them only by touch, fail to recognize them by sight, even at very short distances, but know them at once by touch. The spiders investigated seemed very partial to red-lighted areas. They were, however, such as "are found during the day, running among dead leaves or hiding under stones or wood." The experiments made are unfortunately not fully conclusive ; for the differences of illumination in the different areas, which might be supposed to influence spiders of such habits considerably, were apparently not taken into account, and a negative conclusion as to temperature was drawn from the disinclination of a single specimen, blinded with parafine, to change the places in which he was set down. Feigning of death differed much in different species ; 210 experiments on 19 species were made. Most spiders do not instantly become still, nor remain absolutely motionless. They showed nothing of a cataleptic condition, and were not insensitive to pain. Keeping still in one place serves the double purpose of rendering the insect less conspicuous, and keeping it where it can easily find its way back to its web. Running and jumping spiders whose dependence for escape is in their agility, show this instinct poorly developed or not at all. The cocoons of other genera or pith balls could be palmed off on some for their own cocoons (though when a cocoon and a pith ball were presented at once they chose the first), and one even accepted a lead shot covered with web, much to the discredit of her muscle sense.

III.—HYPNOTISM.

Einiges über Suggestion. ERNST JENDRÁSSIK. Neurol. Centralblatt, May 15 and June 1, 1888.

The subject of the experiments described in this paper was a woman of twenty-seven years who had added to a family history of suicide and apoplexy a personal history of convent life, seduction, theft, three years and a half in men's clothing and occupations, jail

and hospital residence, and major hystero-epilepsy. She was anæsthesic on the right side, and the visual fields of both eyes, especially the right, were reduced. She was hypnotizable at a word and very open to suggestion. She showed all the common hallucinations, followed suggestions, made in the hypnotic condition, after awakening, without memory of the suggestion; could in the same way be made to cease breathing for from 2½ to 3½ minutes, or to become unhypnotizable. But the most interesting experiments were with suggested burning. Besides being blistered with filter paper and burned with a paper box so as to take three weeks in the healing and leave a scar, when a notched ring was applied to her left arm a completely corresponding blister appeared on the right. A letter *K* stamp, such as is used in marking washing, was pressed for hot iron upon her left shoulder without her having seen it, and a blister developed on the corresponding point of the right shoulder representing the form with considerable exactness, but *reversed* as in mirror-script. Another experiment of the same nature was as follows: A letter *J* was drawn on paper, shown to her, and pressed on her left arm as glowing metal. This letter was transferred, but *not* reversed. Experiments with the magnet were very successful so far as transfers were concerned, but the author could not convince himself that the effects were due to magnetic influence. The experiments were executed with great care, and what the author had partly in mind, namely, that well developed hypnotism is not a local phenomenon of France, is unmistakably demonstrated.

After recording the experiments, the author gives his theory of the psycho-physics of hypnotism and suggestion. His view, the reasons for which were set forth in an earlier paper (*De l'hypnotisme: Archives de Neurologie*, 1886), is that the hypnotic sleep is caused by a cessation or limitation of the associative functions of the brain. When awake there is constant associative action; we cannot stay long upon one idea, but in the hypnotic state there is little or none of that action. A stimulus then, instead of starting a train of ideas, acts with concentrated force upon the limited area, the suggested idea is conceived with great force and clearness, and persists like a cataleptic posture. The author follows the Nancy school in making suggestion cover every kind of hypnotic experiment.

The explanation of transfer is not easy, though it probably has affinities with hysterical hemi-anæsthesia. Its connection with suggestion is shown in the letter-burns above, where the letter known only by touch was symmetrically reversed, and the one seen was transferred without reversing. The case gives an uncertain sound for the curative effects of hypnotism, for though the seizures became less frequent and could be cut short in the premonitory stage, or even prevented for considerable periods by suggestion, the relief was not perfect. During a period of several months when she was little hypnotized, the patient underwent a change, increased in weight and grew worse in behavior, and evidently entered upon a different period of her cycle. She still served to show in a mechanical way the earlier and frequently repeated experiments, but she was less susceptible to new suggestions, and remembered what happened when she was hypnotized. The reason for her change in this particular, the author finds in the illusionary feelings that possessed her. The associations to which they corresponded could not be loosened by suggestion.

Einige therapeutische Versuche mit der Hypnose. SPERLING. Neurol. Centralblatt, June 1, July 1 and 15, 1888.

Dr. Sperling has applied hypnotism in a number of cases with good results, and in these articles describes eight of them. Half were of hystero-epilepsy, two more of hysterical paralysis, and the last two of hysteria in connection with the after effects of malaria and typhus. The first case, that of a young man, is particularly interesting. He came under observation in September, 1887, with well marked fits. His heredity was good and the disease of traumatic origin. Electrical treatment had to be given up after a single application, and hypnotizing was tried as an experiment. He proved very susceptible to suggestion and showed improvement at once. The hypnotizing was followed up with other vigorous treatment, and though he relapsed three times from sufficient causes, by the first of January, 1888, he was recovered and at his place as head bookkeeper of a large business house. The part played by the hypnosis, which was produced about eight times only, was the prevention of the fits, thus paving the way for other treatment. The change which it made seems to have been the substitution of lighter equivalents—at least, several attacks of dizziness and faintness, and, later, two of griping and diarrhœa, were so regarded by the doctor. The next case was of a married woman whose first seizure followed the relation of a horrible incident to her when in a state of nervous exhaustion following child-birth. The disease later became chronic. The third was a young woman of neurotic heredity who suddenly fell in a fit on the street. With both these the conditions of home life were such as to continue the disease rather than favor its cure, but the good effects of hypnotic treatment were clear, especially in the last, where practically no other remedy was employed. The fourth case was under treatment for too short a time to count for anything except an experiment. In the fifth and sixth the treatment was apparently completely successful, and, perhaps, as far as mere functional disturbance was concerned, in the seventh and eighth. The author does not hold hypnotizing for a panacea; it has failed in many cases, though he has not reported all in which it has been beneficial. And even if it should prove to accomplish only a temporary relief, or one to be completed by other remedies, it is not an unimportant gain to therapeutics. In summary of his present views, he says that the systematic use of hypnotism is justified as a last resort; that its use either in treatment or investigation belongs to the physician; that the therapeutic effect depends on a right knowledge of the disease, on the way of hypnotizing and suggesting, and on the personal influence of the physician over the patient; that definite rules cannot be made for its application, but that when rightly applied it is not, in his experience, followed with bad consequences.

L'hypnotisme et l'École de Nancy. BERNHEIM. Revue de l'Hypnotisme, May, 1888.

This article is a brief and definite statement, by one of its leaders, of eight of the distinctive points of the school of Nancy. The points are in substance as follows: 1. They do not find Charcot's three stages, or any other physiological phenomena, without conscious or unconscious suggestion, and do find them with suggestion. 2. Hypnosis of *les grandes hystériques* is the same as with other subjects.

3. Hysteria is not good material for the study of hypnotism. 4. The hypnotic state is not a neurosis; its phenomena can be produced in normal sleep with many subjects. 5. This state is not peculiar to, nor more easy to produce with the neuropathic than with others. 6. The school does not hold, as has been said of them, that *all* subjects in the somnambulic state are pure automata and controlled by the will of the hypnotizer. 7. All processes for inducing hypnotism reduce to suggestion; and finally, 8, suggestion is the key of every hypnotic phenomenon.

De l'analogie entre l'état hypnotique et l'état normal. J. Delbœuf. Revue de l'Hypnotisme, April, 1888.

Prof. Delbœuf is led by his experiments to an extension of the doctrine of the Nancy school asserting the identity of normal and hypnotic sleep, to the identity as well of the normal and hypnotic waking states.

Étude sur l'hypnotisme et la suggestion. Rifat. *Ibid.*

The author contends for the genuineness of Charcot's three stages, but believes them true not only of hypnotic, but also of narcotic and natural sleep. He considers also that these three kinds of sleep are all essentially the same, and under proper circumstances show the same phenomena.

Traitement de l'aliénation mentale par la suggestion hypnotique. Auguste Voisin. *Ibid.*, May, 1888.

This article is a paper read at a meeting of the French Association for the Advancement of Sciences, at Oran. The author, who is physician in chief at the Salpêtrière, tells of two cases of mania of persecution, in one of which he was able to give relief and in the other to cure by hynotization and suggestion; also of a case of dipsomania of twelve years standing successfully treated in the same way. All three were women. He has been able in two other cases to avoid the excessive violence accompanying menstruation by hypnotizing the patients and suggesting that they sleep through that period.

Sur un cas de tics convulsifs avec échkolalie et coprolalie. Burot. *Ibid.*

This case, once before presented (*Revue de l'Hypnotisme*, Oct., 1887) by Dr. Burot, is again produced to show the action of a purely moral treatment, leading to striking improvement and prospective recovery. The patient is a young woman of good family and education, who had suffered for several years from convulsive attacks in the face and limbs, with enforced utterance of cries and obscene words, together with a tendency to repeat certain words and imitate things seen and heard. The treatment was by persistent "persuasion," that is, suggestion after a somewhat hypnotic manner, though that state was apparently not produced; by counting the movements that she made and making her count them; by having her repeat (auto-suggestion) such phrases as, I shall want to control myself all alone—I will not be forced to say any bad words, etc., and by other similar means. There are in the disease, the doctor thinks, two chief factors, the enfeeblement of the conscious cerebral control and the exaggeration of the automatic functions. The "moral gymnastics" were intended to break up the vicious habits of the automaton and restore to the higher centres their lost control.

De la suggestion et du somnambulisme dans leurs rapports avec la jurisprudence et la médecine légale. JULES LIÉGEOIS. Revue de l'Hypnotisme, June, 1888.

Un nouvel état psychologique. JULES LIÉGEOIS. Revue de l'Hypnotisme, August, 1888.

M. Liégeois, the jurist, whose memoir on hypnotic suggestion was lately reviewed in this journal, gives, under the above titles, two extracts from the forthcoming book into which that memoir has grown. The first is from the chapter on suggestion in the waking state. He recounts a number of experiments in which he was able, without putting the subject into the somnambulic state, to bring about by suggestion sense illusions and the future imperative execution of suggestions as in post-hypnotic acts. He recognizes, however, that the subjects are not quite in a natural condition, though apparently so. The experiment succeeded only with very susceptible subjects that had previously been hypnotized. Their state seemed to be one of concentrated attention to the idea suggested, and this he was able to induce readily by accompanying his words with very energetic fixation of regard.

In the second he gives some recent experiments on the state of negative hallucination, that is, the state in which on suggestion the subject, after apparently awaking, remains unable to perceive a designated person or thing. With Mme. M——, a susceptible subject from the clinic of Dr. Liébeault, he found that, though she gave no sign of perceiving him when he stood before her or addressed her directly or when he pricked her with a pin, or when others asked her about him, yet when he made suggestions to her, impersonally as it were, in a high voice, she carried them out. Tests are fully reported which he made upon Camille S., a subject whom he takes pains to say Dr. Liébeault and he had always found of entire good faith in a four years' acquaintance. Camille S. was made oblivious to M. Liégeois, and when awakened came into complete rapport with all except him. She remained anæsthetic to him alone. Directly addressed by him, she appeared not to hear, but, addressed after the manner of an inner voice, she showed the somnambulic automatism perfectly. She repeated words said to her in this way; immediately forgot them, and emphatically assured a questioner that she had said nothing of the kind. She carried on a conversation with Dr. Liébeault and a M. F——, in which M. Liégeois furnished the matter, though she evidently thought the ideas were her own. All the time her state seemed perfectly normal, and she could hold her own with the assistants. To make sure that she could really see him, though unconscious of it, the experimenter called her by the same kind of impersonal suggestion to find a bottle of cologne (really ammonia) in his own pocket, which she did and enjoyed the perfume. In the same way she removed his shoe, and with it in her hand firmly denied that he was present, and assured her questioner, M. F——, when he spoke to him that he was certainly insane. The experiments support the Nancy theory of negative hallucinations, "a neutralization by the imagination of the object perceived"—rather than that of Binet and Féré, that it is "a phenomenon of inhibition which produces a systematic paralysis." If these things are true, the consequences may be important. They demonstrate once more the breadth and power of the unconscious in psychic life; they promise new means for discovering the author of suggested crimes; and, if the hallucinations of the insane, which often show a negative

as well as a positive character, are of similar nature, they suggest therapeutic possibilities.

Des expertises médico-légales en matière d'hypnotisme; recherche de l'auteur d'une suggestion criminelle. JULES LIÉGEOIS. Revue de l'Hypnotisme, July, 1888.

The real criminal, when crime is committed in consequence of hypnotic suggestion, is, of course, the suggester. But if he is an expert and has suggested as well that his subject refuse, in case he is rehypnotized for examination, to expose him, or to tell any of the circumstances of the suggestion, the discovery of the real criminal seems at first dubious. But from experiments made to test this point, M. Liégeois concludes that in all, or nearly all, such cases it is possible to obtain an answer. He suggested to the Mme. M—— mentioned above, that on awaking she should see and shoot M. O—— ; further, that she be convinced that the idea was her own; that she refuse to name himself as the author of the suggestion; that she swear there was no suggestion, etc. She went through the imaginary killing, was rehypnotized by Dr. Liébeault, and assumed the guilt of the shooting according to suggestion. Dr. Liébeault then suggested to her the following: 1st, that when she sees the author of the suggestion, if there be one, she shall sleep for two minutes; 2d, that then she shall keep her eye fixed on him till the hynotizer says *Assez*; 3d, that she shall place herself before the author of the suggestion, spreading her skirt as if to hide him, till the hypnotizer asks, Why do you wish to hide M. Liégeois? and 4th, that she shall be deaf and blind to the author of the suggestion till the hypnotizer gives the sign for the end of the performance. Everything was executed according to suggestion. On returning to her normal state she had forgotten all. A few days later, similar tests were made upon a young man by the author and Professor Bernheim, with similar or even more explicit identification of the suggester, though in one trial the professor was able by insistence partly to break down the suggested amnesia. From these cases it would appear that though the subject may be unable to reveal the suggester directly, he can be got to do so indirectly by acts of which he does not see the bearing, indeed by anything not specially interdicted in the original suggestion.

The *Revue de l'Hypnotisme* for April summarizes a series of articles on *L'hypnotisme et la suggestion en obstetrique*, by Drs. Auvard and Secheyron, from the files of the *Archives de Tocologie* for the early part of this year. From a careful study of eight cases in which some degree of hypnotism was produced, they concluded that hypnotism, probably in all its forms, is possible in accouchement, but is generally more difficult to produce than in the normal state. It serves as an anæsthetic, but is not fully and uniformly successful, because the suggestion may be badly made or not accepted by the subject, or because the uterine pain constantly recalls the subject to the waking state. If hypnotism has any effect on the progress of labor, it seems to be a certain slacking of the uterine contractions. It is not a means that can take the place of chloroform and chloral, except under very unusual circumstances. It may perhaps be used during the dilation of the neck. Suggestion in the waking state with very impressible women, or the use of pseudo-chloroform and the like, may be of real advantage in lessening the pains.

IV.—ABNORMAL.

Zur Localization des sensorischen Aphasie. LEOPOLD LAQUER. Neurol. Centralblatt, June 15, 1888.

While the localization of motor speech functions in the lower frontal convolution on the left side is one of the earliest and best established, that of the sensory speech function, abolition of which results in word-deafness, is not so certain. It has been placed by Wernicke and others in the upper temporal convolution on the left side, and it is to that spot that the case of Dr. Laquer points. It is a good case because the only persistent symptom, and the one that persisted through the year and a half of observation till the death of the patient, was the uncomplicated speech disturbance. The patient was a peasant woman of 74, of good heredity and intelligence, and had been well, except for some hardness of hearing, from old age. In the fall of 1886 she had two fainting spells, from the first of which she recovered in a few minutes with no after effects beyond a somewhat more rapid and excited manner of speech. With the second she had a transient paralysis of the right arm and leg, and immediate and lasting word-deafness and paraphasia. After the second attack she showed loss of the knowledge of the use of things (apraxia), did not know how to use scissors, nor how to dress and undress herself, polished boots with the wood of the brush, etc. But this passed away in a few weeks and left her, as far as could be seen, of sound mind. Samples of her talk are given. At first it was necessary to communicate with her by signs, but after a time she relearned the meanings of a few phrases and household words, and used them correctly. Tests for word-blindness were rather inconclusive, from her lack of education. The only psychic symptom was a certain changeableness of disposition ; she was often ill-tempered and even angry at not being understood. During 1887 the patient grew decrepit and died, in February, 1888, of a catarrhal pneumonia. The autopsy showed a spot of softening on the forward part of the first temporal convolution on the left side, another on the posterior third of the same, and a small superficial one between the angular and second occipital gyri. Sectioning showed the fibres softened below the insula as far as the basal surface of the putamen, inward to the claustrum, upward to below the most ventral portion of the posterior central convolution, and backward along the fibres of the inferior parietal lobule to a point where a plane would cut it if passed perpendicularly through the highest point of the interparietal fissure. Elsewhere in the brain there was no sign of disease. Cuts are given representing the brain as a whole and in section.

Of the author's reflections on the case, the following are interesting : Word-deaf patients in general rapidly recover their understanding of words. That this one did not may have been because of the depth of the lesion and its having involved the fibres of the insula. Or, if we should refer the language function, with Charcot, to four coöperating centres (motor centres for written and spoken speech, and sensory centres for heard and seen speech), the quick recovery of other cases might be due to the help of the remaining centres. This woman's slow progress would then be explained by her having only one cultivated centre left to help ; for her centres for seen and written speech had been little cultivated, or not at all. Kussmaul has held that intact intelligence is never present with

apraxia. The contrary was true in this case. Dr. Laquer is inclined to look upon it here (though he admits that it may have been only an effect of the other disturbances) as the result of psychic blindness from the small lesion on the edge of the occipital lobe, and to find the reason for its early disappearance in the small size of that lesion.

A case of thrombosis of the longitudinal sinus, together with the anterior frontal vein, causing localized foci of hæmorrhage, which produced remarkably localized cortical epilepsy. VICTOR HORSLEY. Brain, April, 1888.

The progress of one of these fits is thus described: "The patient was lying on his back; first the head turned to the left, and he made a slight moaning noise; then the eyes turned upwards; he threw the left arm straight forwards, then upwards and outwards; the head then turned slightly to the right, and lastly both legs became convulsed, the mouth slightly open." In later ones, "extension of the wrist, with an interosseal position of the fingers," was noted. The autopsy showed lesions on the right hemisphere of the posterior one sixth of the middle frontal convolution and the edge of the superior, with congestion of the ascending convolution, especially in its adjacent edge and of the membranes of the superior frontal sulcus, and, on the left hemisphere, of a portion of the forward half of the middle third of the superior frontal convolution. And there was also on this side a general thin fibrinous exudation adhering to the dura mater. The case is interesting "in localizing the situation in man of Dr. Ferrier's area for the turning of the head and eyes to the opposite side, and at the same time the anterior limit of the upper limb area, together with the special representation of the segments of that limb at the anterior part of the region devoted to it."

Essai historique et critique sur le délire des persécutions. J. H. E. MANIÈRE. Inaug. dis., 1886.

This essay traces the resemblances of the possessions, sorceries, demonopathies, and psychic pestilences of the Middle Ages to the modern delirium of persecution, the sufferers from which fear poisoning or think themselves wrought upon by electricity, telephoning, etc. All are found to be alike in nature, but taking their special coloring from the knowledge and superstition of the times. In the same way the ideas of greatness that make the emperors, millionaires, and great personages of the asylums were paralleled in those days by the prophets, the Messiahs and the Beelzebubs. The author finds both the ideas of persecution and those of grandeur to be stages of chronic delirium, which, when it shows its full course, begins in a period of incubation, upon which follows the stage of persecution, then that of exaltation, and finally dementia. The logical transition from the second to the third stages is something like this: I am fearfully persecuted; but men of humble station are never persecuted; ergo I cannot be a man of humble station.

On Arrested Cerebral Development. B. SACHS. Reprint from Journal of Nervous and Mental Disease, Vol. XIV, Sept. and Oct. 1887.

It is reasonable to suppose that arrested development should throw light upon normal function in much the same way as degenerations, but the brains of idiots have rarely been minutely studied

with this in view. Dr. Sachs contributes such a study of the brain of a child two years old. Besides simplicity of fissuration, etc., there were found, on microscopical examination, scarcely any pyramidal cells, either large or small, in normal condition. The author is of the opinion that the changes were those of simple arrested development, not those caused by inflammation. The cause of the arrest is not assigned, but the fact that the mother was thrown from a carriage during pregnancy, though she was uninjured, is not to be left out of consideration.

Somnambules Zeichnen. GUSTAV GESSMANN. Sphinx, August, 1888.

This paper, originally communicated to the *Psychologische Gesellschaft*, of Munich, presents the case of a somnambulic artist and gives two reproductions of his work. The artist is a young man of the better class, and has frequently been observed, it is said, by noted physicians of Vienna and practiced observers who testify to the genuineness of his state while making the drawings. His glance at these times is peculiar; his right arm is stiff and cold and frequently convulsed as in cramp. This continues several minutes, when, suddenly snatching paper and pencil, he begins to draw. He generally makes heads or landscapes of a weird or mystical character. He draws rapidly, apparently not sketching an outline, but hatching the surface over with tangled zigzag lines in which the picture gradually takes form. A head which is reproduced, and by the way would answer well for Lear in the storm, was made in an hour and ten minutes of constant work. The other reproduction, of allegorical significance and hardly to be described, took three hours. In it there is certain lettering which can be made to spell out the stanza:

> "Mensch lebe fromm,
> Es ist so Gottes Wille.
> Er lenket stets die Welt,
> Wenn auch in aller Stille."

According to his own account this picture was produced under the influence of a dead painter named Seleny, who has also communicated to him at a later sitting much about its signification, which, however, would not be of interest without the picture. The editor of *Sphinx* notes the similarity to the paranoiac designs in the last number of this journal.

Traumatic Insanities and Traumatic Recoveries. SELDEN H. TALCOTT. Am. Jour. Insan., July, 1888.

This paper, which was among those read before the association of Asylum Superintendents, in May, gives two cases of insanity and two of recovery traumatically caused. The first case is interesting psychologically. A lad of eighteen fell twenty-six feet, striking the back of his head. He was unconscious for a few hours, but only in bed one day. He had dull pain for a time at the base of the brain and down his back; this, however, was gone at the time of his commitment to the asylum, and he seemed otherwise physically sound. In the six weeks previous, however, he had spoken only two or three words, though he could converse easily in writing. He wrote that all spoken words sounded to him like noise without meaning.

He could hear, but not acutely. He was committed in consequence of an attack upon his mother made during a passionate outburst. At the asylum he was put to bed to try the effect of quiet. He shortly began to complain again of headache. This rapidly became intense. In the midst of it, however, like one waking from sleep, he looked about and asked where he was and conversed rationally. The headache decreased, and after due time he was discharged well. Of the six weeks of his sickness he had no memory whatever, though he was clear as to events before and after it. The second case was a woman who developed mania from a cranial fracture after eighteen years. The third was lastingly and rapidly cured in a seventh attack of mania by a fall on his head received in some of his antics, and for the fourth, a blow on the head from a fellow-patient had the same happy effect.

On Paralysis by Exhaustion. CH. FÉRÉ (Paris). Brain, July, 1888.

Dr. Féré gives two cases of paralysis due to exhaustion. The first was a blacksmith who, by two hours of extra work, brought on right hemiplegia, most marked in his arm. He was not, as far as could be found out, of neuropathic stock, but as a child had had nocturnal tremors and chorea. He was slightly anæmic, but without structural defect. When examined he was found anæsthesic on the right side —most so in the arm, the position of which he could not tell in the dark. In walking he dragged his foot. The visual field and the acuteness of the right eye were reduced, but there was no color blindness. The knee-jerk was increased. There was a certain hysterical element in the case, and the trouble was diagnosed as functional. The patient recovered with tonic treatment. The second case was a somewhat anæmic young woman of neurotic family, who brought on left hemiplegia by nine hours of practice at the piano. She had some power of movement in the upper arm, but little in the forearm and fingers; could not stand on the left leg with eyes closed, and dragged her foot in walking. The knee-jerk was normal. There was some anæsthesia of the leg, and the forearm was insensible to contact, pinching and temperature. The position of the hand and fingers could not be told with the eyes closed. In both cases the dynamometer showed increased power on the well side, which declined as the injured side recovered. A similar thing has been noticed in hypnotically suggested paralyses. In organic hemiplegia, on the contrary, the well side generally shows a concurrent decline. Dr. Féré notes this as a possible distinction between the two. In these two cases, and in others cited, an "idea" has played a part, but one secondary to the exhaustion, just as in a hypnotic subject the suggested idea of paralysis is more quickly taken up if it follows some depressing suggestion, or a therapeutic suggestion is more effective after one of increased vitality.

Insanity and the Care of the Insane. CLARK BELL. Read before the Medico-Legal Society of New York, March 9, 1887.

Inaugural Address of Clark Bell as President of the Medico-Legal Society of New York, January 10, 1888.

The first section of the first of these papers collates between forty and fifty definitions of insanity, to which the author finally adds his own. He speaks next briefly of the history of asylums in the

United States, and of the lack in our States of such a supervising body as the English Lunacy Commission. He denounces mechanical restraints, and recommends the boarding-out system for all sufficiently harmless patients. He justly condemns corporal punishment of the insane, and pronounces against the loose methods by which they are committed and sometimes executed.

The Inaugural Address outlines the work of the Society, and mentions the leading medico-legal societies of this country and Europe, and the leading European journals.

On Insanity in relation to Cardiac and Aortic Disease and Phthisis. W. JULIUS MICKLE, M. D. London, 1888. pp. 93.

This little volume contains the three Gaulstonian lectures delivered in March before the Royal College of Physicians of London, and before printed in the *British Medical Journal*. The subject is introduced by a discussion of intra-cerebral circulation, and the dependence of mental states upon it. Cardiac disease may induce psychic disturbance by altering the adjustment of either the general or intracranial circulation, by causing changes in the quality of the blood in general circulation or in the brain, by leading to pulmonary disease, or by giving rise to a host of strange and painful sensations, a fruitful soil of delusions and hypochondria. Of the various forms of insanity that rise from heart disease, or are colored by it, or spring from a common diåthesis with it, very many are of a depressive character, melancholia, hypochondria, delusions of persecutions, etc., or moroseness, querulousness, etc. Even where they begin with expansive and exalted states, the tendency, as the heart disease becomes grave, is toward depression. Many cases of phthisis also are melancholiac, but in a portion the connection of insanities of a more active type with the lung disease is very clear. The special connections of cardiac and aortic lesions are demonstrated in a careful classification of 236 cases (165 individuals, all males), almost all of whom were under Dr. Mickle's care, and examined *post mortem* by him. For these connections, and those of phthisis, the reader must be referred to the book itself.

Ueber Simulation geistiger Störungen. FUERSTNER. Archiv für Psychiatrie, Bd. XIX, Heft 3.

The asserted rareness of simulated insanity does not find support in the experience of urban institutions and those having to do with the criminal classes. Prof. Fürstner finds that of the twenty-five persons under accusation of crime sent in nine years to the Heidelberg Klinik for examination, at least twelve, and perhaps a thirteenth, were feigning. Knowledge, sometimes the most exact, of the diseases copied is acquired by contact with the insane in prisons and hospitals and in the family, from newspaper accounts, and sometimes from slight attacks experienced in themselves. The insanities feigned may be gathered into four groups : first and most frequent, imbecility with apathy, dumbness, or distorted reactions in word and deed ; second, disturbances or absence of consciousness, usually asserted to have existed at the time of the criminal act and usually accompanied by sense illusions, with strange talk and behavior at intervals ; third, variable symptoms, changing irregularly and not fitting any of the common kinds of insanity ; fourth, excited

states with confused and senseless expressions and inclination to violence. Scattering cases like the feigning of paralysis or the assertion of sense illusions are not included in these four. All get their character from the mixed notions of insanity in the lay mind, and the first gets its frequency from the common notion that the insane are entirely abnormal, answer the simplest questions absurdly, and the like. Forms of insanity in which a pathological emotion is the chief symptom, as mania or melancholia, are seldom attempted, (Prof. Fürstner does not know of an unexceptionable case), because, perhaps, the feigners instinctively foresee the great difficulty of maintaining false emotional states for long periods of time. The characteristics by which the doctor is to know the assumed insanity from the genuine are given in some detail in the article. They spring in general from ignorance, under or over acting, or from the absence of symptoms not to be summoned at will, like the hallucinations and flood of ideas of mania. The greatest difficulty of all is with those whose criminal histories of drink, excesses, head-wounds, epilepsy, instability, and imprisonments have produced in them psychical anomalies which, though not psychoses in a narrow sense, yet, when they become associated with hypochondriacal notions and a general proneness to exaggerating and lying, give strange colors to genuine psychoses, and make them hard to classify and only to be pronounced upon after long observation. To show with what persistence and exactness such simulation can be carried out, the doctor relates a case of a seventeen year old girl who feigned paralysis and spasm exactly, denied that she ate, alleged visions of a guardian angel, had the nerve to put a nail through first one foot and then the other in imitation of the crucifixion, and carried on a various course of deception, the feigning here being not to escape punishment, but to excite superstitious attention.

Les faux témoignages des enfants devant la justice. A. MOTET. Paris, 1887. pp. 20.

The testimony of children, when delivered in evident sincerity, is of the most telling kind. Dr. Motet, however, recites four cases from his own experience, and cites others, in which such testimony has proved utterly false. This lying is not malicious; on the contrary, the child believes he is telling the truth. Children of precocious and disproportionately developed imagination fail to distinguish what has actually happened from what they have heard, or what has perhaps been suggested to them by their very questioners. Bad nervous heredity is often an element in such states of mind, and their relation to cases of hypnotic suggestion is close. Such cases as these widen still further the field in which doctors and lawyers must coöperate.

V.—ANTHROPOLOGICAL.

Remarks on Crime and Criminals. HENRY MAUDSLEY, M. D. Journal of Mental Science, July, 1888.

The writer protests against the present ignorant inclination to see in every criminal a diseased person who should be treated for disease and not for crime. A cursory glance shows two distinct classes, "the occasional or accidental," and "the natural or essential criminal." To the first belong those who, though of no worse moral fibre than

their associates, yield to the stress of ill-timed temptation. From these the descent is by all gradations to the "essential criminal," who suffers from some hopeless moral or intellectual lack. Difficult and well-planned crime is beyond him, though he may murder recklessly or from a "blind gloomy feeling of painful tension and unrest"—an act between epileptic and cold-blooded crime. But there is here no "special criminal neurosis"; he is what men were in the pre-moral stage. With those, however, that come of criminal or neuropathic stock, who are congenitally immoral, we may begin to speak of the "special criminal neurosis." A third class, and it is quite distinct, is of those who are positively diseased—the insane whose crimes are of their disease. From none of these considerations does it appear that society should not punish crime. The punishment may become a future restraining factor in the criminal and in others. To admit this does not commit one to punishing the insane, for such punishment is not deterrent, but shocks the moral sense of society. The really valuable study of criminology is that of the insane and those whose tendency to crime is hereditary; it is a full study of special cases, using prisons as hospitals are used in the study of disease. From such study may be expected a psychology of crime, upon which legislation can be safely built.

Negro Myths from the Georgia Coast. CHARLES C. JONES, Jr., LL. D. Houghton, Mifflin & Co., Boston and New York. 166 pp.

These stories are like those made popular in the mouth of Uncle Remus. Most of them relate the doings of animals that seem constantly wavering over into men. In such stories we see, perhaps, how our own were-wolves and swan-maidens looked minus the halo of poetry they have gathered in their decay. Several are of interest as showing the transformations undergone in entering another mythic family. The story of "De Debble and May Belle" is Bluebeard except at the ending, and the main lines of the story of Buh Lion's treasure-house are very near to that of the treasure-house of King Rhampsinitus, told in the second book of Herodotus, and elsewhere in fiction under other titles.

On the Shell Money of New Britain. Rev. BENJAMIN DANKS. Journal of the Anthropological Institute, May, 1888.

From the interesting account of Mr. Danks it appears that the natives of New Britain have a tolerably elaborate economic system founded upon their shell money. The rights of property are well defined. They discriminate buying and barter, having separate words for each. Prices for some articles are fixed by custom, but others vary with the supply. On the Duke of York Island the idea of interest is clear, and the established rate is ten per cent; on New Britain, however, that idea is not yet perfect, the extra tenth returned being regarded as a present expressing thanks. A man who repudiates his loans loses his credit, likewise one that is lazy or a poor hand at business. There is no central authority, but custom is enforced by a rude expression of public opinion. Crimes, except probably those against the exogamous marriage customs, are atoned for by money payments, the amount of which is settled by the higgling of the injured and the injurer supported by their friends and retainers. Even in war no peace is secure until the warriors of both sides have paid for the killing and wounding they have done.

This naturally acts as a strong preventive of war. The manifold influence of this commercial system upon the customs of the people, and the abuses to which it is put (many not unlike those of more advanced commercial communities), cannot be summarized here; suffice it to say that it penetrates their whole lives and enters their ideas of a future state. It gives them the thrift and industry and the hardness and selfishness of the commercial view of life. To judge from this account, these savages are almost the typical individualistic economic men so often appealed to by the orthodox economists.

On Tattooing. Miss A. W. Buckland. Journal of the Anthropological Institute, May, 1888.

The author collates briefly the facts of tattooing, in support of a theory of prehistoric intercourse. Of the two methods, by gashing and by pricking a pattern in, the first is found almost exclusively in Australia and Africa, where it is probably of tribal significance, or sometimes the badge of a secret society. In New Zealand and the Pacific islands its general purpose is decorative, and on men a decoration for bravery, but also tribal and referring in its pattern to special events. A woman tattooed on the chin is almost everywhere a married woman. Tattooing at the entrance upon manhood and the instruments used in tattooing, frequently pieces of human bone, are only incidentally touched upon. A map of the world shaded to show the distribution of the methods of tattooing, and of the chin-marks of women, and the regions where the art has formerly been practiced, accompanies the article.

Notes historiques sur les Aïssaoua. G. Delphin. Revue de l'Hypnotisme, May, 1888.

After something of the legendary history of the founder of this Moslem sect and his miracles, a brief account of their *hadhra* or religious seance is given. In the *hadhra* the devotee dances himself into nervous exaltation, to chanting and drum-beating. In this neuropathic state he also performs miracles, but each has his own; the one who works himself into catalepsy does not let a viper bite his arm, and the snake-bitten does not eat cactus leaves. On entering the order each chooses what he will do and is placed in charge of an adept.

On the Evolution of a Characteristic Pattern on the Shafts of Arrows from the Solomon Islands. Henry Balfour. Journal of the Anthropological Institute, May, 1888.

The author traces the decoration of the shafts back to the trimming of the joints of the reeds from which they were made. The hard surface tended to peel off in slivers. This was stopped by transverse cuts, and suggested the pattern which is composed of lines running lengthwise of the shaft; and placed just ahead of the joint. On some the pattern is tolerably elaborate, and applied even where its use was forgotten or neglected. The explanation is supported by eight specimens figured in an accompanying plate.

Flowers and Flower Lore. Rev. Hilderic Friend. pp. 704, 2d edition, illustrated. London, 1884.

This volume is a thesaurus of extra-botanical information about

flowers, their connection with fairies and witches, proverbs based upon them, their medicinal virtues according to the old-time herbalists, their use in heraldry, their names, etc. It is written, perhaps unavoidably, in a somewhat rambling style. The materials were in part gathered by the author directly from the mouths of English peasants; but there is also liberal citation of prose and verse from other sources. The book contains besides bibliographical notes, a catalogue of more than 160 authors who have dealt with these subjects more or less directly.

The *Correspondenz-Blatt* of the Gesellschaft für Anthropologie, etc., announces the formation in February of this year, of a Russian Anthropological Society, with its seat at the Imperial University of St. Petersburg. Its president is Dr. A. A. Jostrantzeff, Professor of Geology in the University; its vice-president and secretary are Dr. A. J. Taranetzki and Dr. S. N. Danillo, both of the Imperial Academy of Military Medicine.

The same journal notices the first doctorate conferred by a German university on a candidate who offered modern anthropology as his principal subject. It was granted *summa cum laude* by the University of Munich to G. Buschau, M. D. The title of his dissertation was: "Prähistorische Gewebe und Gespinnste; ein Beitrag zur Kulturgeschichte."

A prime object of the American Folk-lore Society, organized early in this year, is the support of a journal that shall put in available and permanent form the fast disappearing remnants of native and transplanted American folk-lore, and afford opportunity for special studies on these and connected topics. The first number of the new journal, April-June, contains articles on the Diffusion of Popular Tales, by T. F. Crane; Myths of Voodoo Worship and Child Sacrifice in Hayti, W. W. Newell; Counting-out Rhymes, H. Carrington Bolton; Lanâpé Conversations, D. G. Brinton; Onondaga Tales, W. M. Beauchamp; On certain Songs and Dances of the Kwakiutl of Brit. Col. (with music), F. Boaz; Songs of the Hecucka Society (with music), and Stories from several Indian Tribes, by J. Owen Dorsey; and in addition bibliographical and miscellaneous notes.

VI.—MISCELLANEOUS.

Hygiene of Reflex Action. HENRY LING TAYLOR, M. D. Journal of Nervous and Mental Disease, March, 1888.

The balance between man's body and its environment is kept up chiefly by reflex action, little of which in health comes into consciousness. Vigorous life of the body requires vigorous reflexes, responsive to a wide range of external stimuli. They can remain so only while they receive such stimuli; centres deprived of their stimuli from disuse or any other cause decline in power, and the reactions over which they preside are as it were forgotten. One reflex cannot be at its best while others are ill developed; they are mutually affected. Even a reflex frog reacts less powerfully with one leg if the nerve of the other is severed. Many of our reflexes and the adjustments of the centres which control them are only partly

innate, and are gained by trial and frequent repetition, and if lost or weakened or deranged, are to be restored in the same way. The proper action of reflexes is interfered with if pain comes to accompany the use of any set of muscles. A man's leg is injured, it hurts him to walk as he used, consciousness interferes and he walks from his volitional instead of his reflex centres, till perhaps new adjustments of reflexes are formed. He has acquired a trick of walking which may long outlast the injury that caused it. To walk as he used, he must re-educate his reflexes. Some cripples have never had their reflexes brought into the best working condition. These propositions, which have a very wide application, Dr. Taylor illustrates from his own orthopedic practice, where their application is most direct. He gives thirteen cases where education or re-education of the deranged reflexes was attended with the greatest success, and several in which the cure must have seemed little less than miraculous. The process of education aims to give the unused centres the stimuli they need, and through them to bring about the reinvigoration of the whole. The means used are chiefly movements, passive and active (the first executed by steam power), and appropriate rest. What the author wishes "to emphasize as the central idea of this paper, is the development and use of the associated reflexes, as a practical means of modifying nerve-centre function."

Les Odeurs du corps humain dans l'état de santé et dans l'état de maladie. E. Monin. Paris, 1886. 128 pp., 2d ed.

The subtitle of this little book (*Un nouveau chapitre de séméiologie*) gives its scope. The aim is, by gathering together the scattered observations on the subject, to rehabilitate a diagnostic help now unfortunately too little used. Odors are the evidences of subtle changes, and as such are of high value to the physician whose sense of smell is keen and educated enough to make use of them. Experiments noted in the last number but one of this journal show the extreme fineness of this sense—not to mention the marvellous discriminations of savages and certain deaf mutes. The author treats of the odors of the skin and its appendages, of the breath, of the sputa, of the vomits and eructions, of the fæces and intestinal gases, of the urine, of the female genital organs (the odors of the male organs are less important and treated in other sections), and of purulence and gangrene. The description of these odors is, of course, obscured, as any treatment of the subject must be, by the lack of definite descriptive terms. Though the book was written for physicians, it contains matter of interest to the psychologist; the part that odors play in the sex-functions of plants and animals gives them, at the very least, an evolutionary interest. The book deals with clinical facts, and is as good in its way as the theories of Jäger are bad in theirs.

Essai de Psychologie Générale. Charles Richet. Paris, 1887. 193 pp. F. Alcan.

In this little book the editor of the *Revue Scientifique* has aimed to present the general principles of psychology unobscured by detail and in systematic form. The style is lucid. Working from a physiological standpoint, he develops mind from irritability, one of the fundamental properties of living matter, through reflex action and instinct up to consciousness, memory and volition. The conclusion is an extension to men of the Cartesian mechanical theory of animals.

The Will Power; its Range in Action. J. MILNER FOTHERGILL, M. D. James Pott & Co., New York. 184 pp.

"This is not a metaphysical inquiry," says the author, "but a practical book, which it is hoped will be found useful by many, especially those entering the battle of life." The will is treated in relation to inherited character, to self-culture, to the mastery of men, and to disease. Illustrations are largely drawn from English history and literature, frequently from George Eliot. The book ought not to be without interest to those for whom it was written, and perhaps not without effect in encouraging determination; but it has about as little to recommend it to the psychologist (for whom indeed it was not intended) as for the metaphysician. A book might be written on nearly the same lines, equally neglectful of speculation and even more practical, bringing in the contributions of physiology and more accurate analysis, which would pass muster psychologically, and, at the same time, be far more impressive by reason of the freshness and directness of its suggestions.

Cerebrology and the possible something in Phrenology. S. V. CLEVENGER, M. D. Am. Naturalist, July, 1888.

Of all the bastard sciences, there is none that finds more ready scorn and that it takes so much courage to look at seriously as phrenology. Dr. Clevenger has, somewhat against his inclinations, taken such a look, and sees some points of coincidence between modern cerebral localization and the skull localization of the phrenologists. On the basis of the generally conceded motor and sensory areas, and a speculative location of the regulative and associative functions in the remaining "blank-spaces," he finds some plausibility in locating firmness, self-esteem, and continuity (cerebral control of the body) over the motor centres for the arms and legs; cautiousness, conscientiousness, approbativeness (of an inhibitory nature), over the rearward blank-spaces; benevolence, hope, ideality, constructiveness (inhibitory-coördinating), forward of the motor and rearward of the intellectual area; amativeness (animal trait), over the occipital ridge and mastoid process, depending on the development of the neck muscles; and so on with three or four other groups of faculties. Whatever fails of justification in some such manner is returned again to limbo.

Comparative Physiology and Psychology. S. V. CLEVENGER, M. D. pp. 247. Chicago, 1885; A. C. McClurg & Co.

This moderate-sized volume attempts to embody with some system, as introductory to a larger work contemplated, the various ideas advanced by the author in papers published in different periodicals. The scope is broad; such questions are discussed as the primitive evolution of life and mind, the physiology of protoplasm, the evolution of organs, the significance of embryonic development, alternation of generations, heredity, adaptation, and allied subjects. Many facts are massed together without further attempt to show their bearings. There is a lack of classification of the ideas that leads to confusion, and many of the sentences are so loaded with abstruse terms (increasing the obscurity due in part to the condensed form of presentation) that a satisfactory synopsis for a brief review is impossible. Two or three chapters, however, like that on the morphology

of the brain and that on the expression of the emotions, are tolerably clear.

The author is indebted in large measure to Bain, Spencer, and Darwin, but is ultra-radical in his physical conceptions of life, and he does not conceal his antagonism towards the old-school psychologists. The great problems that engage the attention of investigators are answered with naïve certitude, and the author's speculations as to the mode of evolution of organs are as fanciful as those of Lamarck and involve principles even more mechanical. There are, however, a number of excellent similes and many highly suggestive thoughts which make the work worth reading to one familiar with the problems discussed. As serving to give the novice a notion of physiological psychology, we think it misleading; and it will rather alienate than instruct members of the metaphysical school. The mechanical theories that attempt to explain nerve physiology are too artificial, and generally assume properties for the atoms that involve the very points contended for by the metaphysicians. In referring physiological processes in nerves to physics and chemistry, we on the one hand do not detract from the interiorness of mind, nor do we on the other hand explain the *modus operandi* of these forces. The metaphysician errs in denying the intimate relations between physics, chemistry and psychology; the radical errs in thinking the mysteries of life are reduced to simple mechanics.

J. N.

NOTES.

In the April number of *Mind*, Prof. Royce suggests that sane persons may be subject to illusions of memory, similar to the false memories that occur in cases of insanity like those studied by Kraepelin and others; and he thinks that the liability to such illusions may account for some of the stories of haunted houses, telepathy, and the like, reported by honest witnesses. A great deal of research and observation is required to determine how common such illusions of memory are among normal persons. Several philosophers, however, have noticed that illusions of memory occur in dreams; and, judging from the writer's own experience, such phenomena are not uncommon. Several dreams illustrative of paramnesia have come to my notice. One of my own dreams may serve as a sample. It was substantially as follows: I visited the editor of a well known periodical, and inquired about the manuscript of an article that I had sent him some time before, and of which I had received no tidings. The editor made an evasive answer that indicated to me that he had never read the manuscript, but that he was unwilling to confess it. I remembered the fact of having sent the article clearly enough; and the answer that my dream put into the mouth of the editor would indicate that I had no doubt of it. The facts of my waking life were these: I had often contributed to the periodical in question, but no manuscript had ever been rejected. A short time before my dream, however, I had sent an article to a newspaper, and had received no word from it whatever. Here was clearly a case of false memory, unless we suppose it a true memory of a former dream state which had been forgotten in the waking state, just as the events of an hypnotic trance are remembered in succeeding trances, while forgotten in the waking state. W. H. B.

Another evidence of the set, among thoughtful men of quite diverse philosophical tendencies, toward a thorough and scientific consideration of some of the more obscure questions of psychology, is to be found in the recent organization of the Gesellschaft für Experimental-Psychologie in Berlin, and in the program adopted by them, published in the May number of the *Sphinx*. They propose to study in general the phenomena of man's psychic life that occur under unusual circumstances, natural or experimental, and which in a way are a borderland between the normal and pathological. First among these is hypnotism, in the wide acceptation of the term; next, telepathy and related states, and in a secondary way, as probably in a manner connected with these, the phenomena of spiritualism. They rely chiefly upon the experimental method, and have based on its use a distinction of their branch of psychology from the introspective and physiological. Other methods are, however, not to be excluded. Spontaneous cases will be treated statistically, and history and ethnology will be made tributary. The society as a society

will confine itself to facts, leaving their philosophical interpretation to individual preference. All can, therefore, co-operate who recognize the significance of the field of study. Communications to the society should be addressed to Max Dessoir, Berlin, W., Köthenerstrasse 27.

In the *Journal of Mental Science* for July, John Baker, M. B., gives statistics from the records of the Broadmoor Criminal Lunatic Asylum bearing on the relations of epilepsy and crime. From February, 1864, to February, 1887, 1266 male and 394 female patients were admitted; of the males, 105, and of the females, 23, were epileptic, or in percentages 8.2 and 5.8. Of the male epileptics, 67 had committed homicidal offenses; of the female, 18; and four other males had been guilty of personal violence to themselves or others. Only 34 epileptic males and 5 epileptic females had committed other crimes. Of the whole number of homicidal insane admitted (768), 11 per cent were epileptic, while of the 892 non-homicidal admissions only 4.8 per cent were epileptic. It thus appears that criminal epileptics are prone to crimes of violence, especially to homicides. Further tables on the basis of 128 cases show that among the male epileptics the majority were single, while among the females a majority were married. Of the same 128, the age of greatest criminal activity, including homicides, was for the males from 25 to 30 years, for the females between 20 and 25 and between 35 and 40. It would also appear from records as to the ætiology of the disease, that epilepsies from traumatic causes are more apt to show a homicidal character than those of congenital and idiopathic origin. Thirty-one of 105 male cases show a history of intemperance.

In the *Journal of Mental Science* for July, 1888, Dr. S. A. K. Strahan reports four cases of recovery after long periods of insanity. All were women, and in all the recovery seems to have begun in the general nervous reconstruction of the climacteric.

In the *American Journal of Insanity* for July, Dr. J. A. Campbell, of the Counties Asylum, Carlisle, England, gives three cases of recovery after long periods of asylum life. The first was a woman whose menstruation was accompanied by violent maniacal attacks. These declined in violence, and she was discharged after seventeen years of asylum life. But one attack, and that very slight indeed, occurred after menstruation ceased. The second, a man, began to improve after a severe illness of another nature, and was discharged after nineteen years. The third was a woman of fifty-one, whose derangement followed the menopause; she recovered after fourteen years. The doctor queries, since it is rare to find brain lesions to account for delusions and the like, if brain scars, like surface scars, may not grow out and more or less completely disappear in long periods of time.

A paper on "The Treatment of Nervous and Mental Disease by Systematized Active Exercise," by Dr. C. K. Mills, is reported in abstract in the *Polyclinic* for February, 1888. Active exercise and proper hygiene, besides combating that low nutrition which is the soil of much nervous disease, have been found useful in the treat-

ment of such diseases as idiocy, insanity, asthma, minor chorea, habit chorea, hysteria, general nervousness, neurasthenia, nervous palpitations, lithaemia, cerebral syphilis, diabetes, curvatures, ataxias, paralyses, muscular atrophy, aphonia, and writer's disease. In some of these the exercise assists in the establishment of proper nervous habits and of rapport between the will and the muscles, in others it brings calm, in yet others it helps excretion. This paper is said to be the forerunner of a book on the subject.

Dr. Seymore J. Sharkey reports, in the April number of *Brain*, a "case of atrophy of the frontal and parietal lobes of the brain consequent on long-continued paralysis of the limbs from spinal disease." The patient was bed-ridden for two years and a half with paralysis of both legs and the right hand, and for a year before her death, with partial paralysis of the left hand and arm. Sensation was slightly and infrequently affected, and intellection not at all. *Post-mortem* examination showed atrophy in both frontal and both parietal lobes, particularly in the upper ends of the ascending parietal convolutions on the right and the superior parietal lobule. The left corresponded, with noticeable atrophy of the middle third of the parietal convolution, and in a less degree of the frontal convolutions. The tempero-sphenoidal and occipital lobes on both sides were contrastingly well nourished. The case illustrates again the location of the centres of voluntary motion. A cut of the patient's brain accompanies the account of the case.

Dr. Sharkey also reports, in the same place, a case where a tumor on the left auditory nerve caused noise and deafness in the left ear, and dizziness similar to that produced in animals on sectioning the auditory nerve or destroying the semicircular canals, phenomena which have by some been attributed to injuries attending the sectioning; as in the experiments, the dizziness seemed to decrease with time. A cut of the patient's brain is given here also.

Fletcher Beach, the medical superintendent of the Darenth Asylum, Eng., discusses and gives cases (*Am. Jour. of Insan.*, July, 1888) of "some of the uncommon causes of imbecility," *e. g.* syphilis, consanguinity of parents, chronic neuralgia, excitability, and deaf-mutism. The first is responsible for two per cent or less of all cases. Marriages of first cousins, provided there is not inclination to nervous disease, has scarcely an appreciable effect. Chronic neuralgia and excitability of the parents accounts for 14, and deaf-mutism for 2 out of 637 cases. In these, as in others, what is inherited is not idiocy itself, but an instability that develops into it on occasion of some later shock.

In the *Revista Sperimentale*, Vol. XIII, fasc. 2, Oct. 1887 (translated in the *Alienist and Neurologist*, April, 1888), Prof. Tamburini gives a very interesting account of a young Italian girl and her visions of the Madonna. The girl was thirteen years old, of neuropathic heredity, and at the first appearance of the vision, under great emotional excitement and fresh from severe physical exercise. She saw in a juniper bush, a *bambina* about her own size, dressed in white, rosy-cheeked, dark-eyed, light-haired, a blue wreath about its neck, a silver cross on its breast, and its hands folded. It answered questions put to it. Presently, among the superstitious

populace, the juniper bush began to work miracles, and the whole thing had finally to be suppressed by the authorities. The condition of the girl when she came soon after under Prof. Tamburini's observation was rather hysterical; there was slight left hemi-anæsthesia, she had pains and deafness in the left ear, and some hyperæmia of the fundus of the eyes; her muscular force was small. She was excitable, capricious, and egoistic; had been brought up in enforced punctiliousness in religious matters. Her visions were true hallucinations, but her mind, once freed from them, was not apparently unbalanced.

Prof. Nasse (*Zeitschrift f. Psych.* XLIV, H. 4, N. 5, noted in *Neurol. Centralbt.* No. 9, May 1, 1888) contends for the existence of secondary paranoia, *i. e.*, developing out of melancholia or mania, and further, that the development may be sudden. Three cases are given, all women, two melancholiac and one maniacal, in which such a change took place suddenly.

The connection of paranoia with hallucinations of hearing has frequently been remarked. Dr. Theo. W. Fisher, in an article on the subject in the *Am. Journal of Insanity*, July, 1888, gives a table of 243 cases of insanity in the Boston Lunatic Hospital, from which it appears that 63 per cent (and probably more, if the history of the early stages were more perfect) have been hallucinated at some period of their disease. Eight-ninths of these had had hallucinations of hearing. Fifty per cent of the cases of acute mania and general paralysis had been hallucinated, and 91 per cent of the melancholiacs (excluding those of the simple form, which, like those of folie circulaire, showed nothing of the kind). The 47 cases of paranoia all showed hallucinations, and all but two, hallucinations of hearing, seeming to demonstrate more than an accidental connection.

Dr. William Noyes has made a valuable addition to the literature of insanity, accessible in English, in his translation of J. Séglas's historical study of paranoia, now reproduced in pamphlet form from the March, April, May, and June numbers of the *Journal of Nervous and Mental Disease*. The work is a concise résumé of a large amount of literature in French, German, Italian, and English.

In his anniversary address before the Anthropological Institute (*Journal of the Anthrop. Inst.*, May, 1888), Francis Galton gave some account of the anthropometric laboratory then soon to be opened at the South Kensington Museum. The plan is to be that of the one at the International Health Exhibition in 1884. The object is not only to give those desiring accurate measurement an opportunity for it, and to keep a record of such measurements, but also to give information on anthropometrical methods and a place for such research. The laboratory must be able to measure quickly and conveniently a large number of people. It is confined therefore to measurements that can be made on persons in ordinary clothing, but valuable data can even thus be gathered. The remainder of the paper is an explanation of the system of identification measurements of M. Bertillon, mentioned in Vol. I, page 205, of this journal.

Dr. Ottolenghi, from tests made on eighty persons, concludes that criminals are deficient in the sense of smell.

A case of stigmatism is reported in the June number of the *Sphinx*. The stigmatist is a certain Sister Napelle, of the Order de le miséricorde, in the French convent at Chas, in Auvergne.

Carl Kiesewetter, in the July number of *Sphinx*, gives a brief account of the incantations used by the ancient Akkadians to expel disease (or the cosmic demons that caused it), or to transfer it to inanimate objects à la Paracelsus. He gives German versions of two or three of the formulas.

In a paper read before the Anthropological Institute and reported in *Nature*, May 3, 1888, Francis Galton makes some calculations of the head-growth of students at the University of Cambridge, from tables of "head-products" presented by Dr. Venn. The "head-product" is the product of the length, breadth and height of the head above a fixed plane, and while it of course far exceeds the actual brain volume, it may be taken on the average as proportional to it. The measurements were made upon men from 19 to 25 years old and upward, in number as follows: high honor men 258, other honor men 476, "poll" men 361. The average head-product in inches for high honor men at 19 is 241.9, for other honor men 237.1, for the "poll" men 229.1; that is to say, high honor men have heads nearly 5 per cent larger than the "poll" men. Omitting the figures for the intermediate years, at 25 or over they are respectively 248.9, 239.1 and 243.5, showing growth in all and especially in the "poll" men, whose average "head-product" has increased 6 per cent against 3 per cent for the high honor men. From these figures it is to be concluded that the brains of university men continue to grow after the age at which growth ceases among men at large, which is 19 or earlier; that high honor men have larger and earlier developed brains than others, and consequently that university distinction may be taken as an evidence of these advantages.

In an article on the "Life Statistics of an Indian Province" (*Nature*, July 12, 1888), S. A. Hill shows that violent deaths, suicides and wounds are at a minimum in the colder months, increase in frequency during the dry and hot season, and remain high through the rainy season. The "irritability of temper consequent on long continued heat and moisture" is suggested as a possible reason. When the birth rates are arranged by months they are found to be at a maximum in September and October (56.71 per mille in September) and at a minimum in May and June (35.43 per mille in June). This points to December as the month of most frequent conception and September as that of the least. In September, the end of the long hot period, the vitality of the people is at ebb and the food supply low. In December, on the contrary, climatic conditions are favorable and food abundant, November being the month of harvest. Thus there appears to be a human "pairing time" controlled by physical conditions. The fact that the Holi, or spring festival of the Hindus, which has been considered as a relic of such a "pairing time," does not agree with the one found from the figures, is to be explained, the author conjectures, by the importation of the festival from a colder habitat.

In the *Neurol. Centralblatt* for March 1, 1888, Prof. Fr. Fuchs recounts a simple observation on himself, tending to show that the hallucinatory images seen by many persons in the moment of dropping off to sleep are influenced in their localization by the position of the head. The professor noticed in going to sleep in a night train, that these images appeared to move about, keeping time to the motions of his head produced by the shaking of the car.

The association of colors and sounds is not of very infrequent occurrence. Lauret and Duchaussoy report a case (*Bull. d. l. Soc. de Psychologie phys.* III, p. 11; noted in *Centralbt. f. Physiol.* No. 5, June 9, 1888) of a family in which the father, son and daughter have very distinct color sensations on hearing and seeing letters, or even thinking of them. The vowel colors are bright, the consonants shades of gray. Number-words have colors likewise, but unrelated to the letters with which they are spelled. The colors for particular letters are not the same for the father and daughter; the son was not examined in this particular.

Cases in which colors are called out by other senses than hearing are infrequent, but not unknown. Colored smelling has been observed, and Dr. Ch. Féré mentioned at a meeting of the Société de Biologie of Paris in December of last year (reported in the *Neurol. Centralbt.* No. 10, 1888) a case of colored tasting. A woman, after a plentiful use of vinegar, saw everything red for a few minutes, and after that for more than an hour everything bright green. Something similar happens among melancholiacs and the neuropathic without any exciting sensation. Dr. Féré's explanation of such double sensations is something as follows. On stimulation of any sense, there is called forth, in addition to the special sensation, a mass of physiological attendants (changes of muscle tension, of circulation, and of organic functions generally). If now exactly the same mass of secondary effects are called up by the stimulation of two senses, *e. g.* sight and hearing, the two sensations are confused by the percipient, he perceives them together, has color sensations with spoken letters, etc. If we reflect that these physiological attendants are, on the subjective side, probably feelings or indistinct emotions, we may take the liberty of stating Dr. Féré's explanation thus: Stimulation of one of these senses calls up an emotional state common to both, which in its turn calls up the other sensation.

W. Griffiths, in studying the rhythmic waves in the myograph tracings of voluntarily contracted muscles (*Journal of Physiol.* IX, 1, p. 39, noted in *Centrlbt. f. Physiol.* No. 9, 1888), found them to differ for different muscles, for different individuals, and for the same individual at different times. The number was increased to a certain point by loading the muscle or exercising it, but beyond that point it again decreased. The general rate for muscles without a load, and of muscles at "dead strain," was the same, for the biceps about 14 per sec., for the muscle of the ball of the thumb about 10. Fatigue decreased the number but increased the extent of the waves. They represent, in the author's opinion, the impulses of innervation; he discards the rate derived from the tone of contracting muscle, 19.5 per sec.

With the view of determining experimentally whether deep tones are heard with the upper part of the cochlea, Stepanow (*Monatsschr.*

f. Ohrenheilk. No. 4, 1888, noted in *Centralbt. f. d. medicin. Wissenschaften*, July 28, 1888) removed that portion of both cochleas in young guinea pigs. Their hearing after the operation, as indicated by reflex movements of the ears, was not destroyed for noises, nor for tones produced by a violin, harmonica, Galton pipe, B-bass, etc. These results are in diametrical opposition to the conclusions of Baginsky; but the latter seems to have assumed that his animals did not hear when they did not respond—a very doubtful assumption. In the fact, however, that Baginsky removed the lower and middle divisions of the cochlea and found no deafness for deep tones, and that Stepanow himself removed with like result the upper division and part of the middle one, the latter finds support for that theory of the perception of tones which does not distribute particular tones to particular parts of the cochlea.

F. Tuckerman reports (*Journal of Anat. and Phys.* II, 2, p. 135, reviewed in *Centralbt. f. Physiol.* No. 5, June 9, 1888) the finding, in the course of a careful study of the taste apparatus of the rodent (*Fiber zibethicus*), of a ganglion a little less than one third of a mm. in diameter, in the body of the circumvallate papillae. It is set in a connective tissue capsule, and gives off unmedullated fibres in all directions. He found also bodies like the taste-buds imbedded in the epithelium of the posterior surface of the epiglottis.

The studies of A. Lustig (*Atti della R. Accadamia delle Scienze di Torino*, XXIII, noted in *Centralbt. f. Physiol.* No. 6, July 23, 1888) on the olfactory region of rabbits and guinea pigs in different stages of development, seem to show the fibres of the olfactory nerve to be connected with both the epithelial and "olfactory" cells, thus supporting Exner's assertion that all the cells of this region are alike olfactory.

Beaunis has found (*Revue Philos.* No. 5, 1888, noted in *Centralbt. f. Physiol.* No. 7, July 7, 1888), in trying to reproduce, after greater or less intervals of time, distances and directions by muscle sense, that the memory of the movements disappears suddenly, but that after conscious recollection has gone there is a temporary stage in which the distances, etc., may nevertheless be reproduced by unconscious memory.

Charpentier (*Comptes Rendus*, Vol. 102, p. 1155) found that objects at rest, when looked at in a dark field, seem to move from two to thirty degrees a second. He can determine their direction of motion by hard thinking, especially after intellectual or physical exertion. If a sudden noise occurs they move towards it. Aubert (*Pflüger's Archiv*) obtained the same results; he concludes that for the perception or direct sensation of motion, as well as for orientation in space, the presence of objects at rest, and, in general, of well known objects in the field of sight, is of fundamental importance.

Isaachsen has repeated Holmgren's experiments for proving the Young-Helmholtz theory of the color-sense, by throwing small images on separate rods and cones, and, like Hering, he finds it impossible to obtain Holmgren's results.

At a recent meeting of the American Ophthalmological Society, Dr. William O. Moore, of New York, reported three cases of hysterical blindness in males. Two were monocular; one of them, a boy of fifteen, having lost the sight of his right eye "after a disappointment at school." The application of prisms gave double images, showing that the alleged blindness was imaginary. They were told that they would soon be well, and recovered accordingly under electrical treatment. The other case conceived, from the effect of atropine used in testing his eyes for glasses, that he was going blind, put on dark glasses, afterward bandages, would not open his eyes, and for ten months before he was examined by Dr. Moore had stayed in the dark with his eyes covered. He was examined under ether, and on recovering consciousness, evidently could see. He was assured of recovery, and "in two days he was walking around without glasses," and has had no trouble since.

M. Nonne, in the *Neurol. Centralblatt*, Nos. 7 and 8, 1888 (noted in *Centralbt. f. Phys.* No. 6, 1888) contributes to hypnotic therapeutics the case of a type-setter who was successfully treated by that means in a third attack of hysterical paralysis and anæsthesia, complicated perhaps with lead-poisoning. The suggestion was made by degrees, *e. g.* "to-morrow you will be able to move your left great toe," etc., and the disease, which in the right arm was of five years' standing, was in this manner completely removed.

One of the most prominent advocates outside of France of the therapeutic use of hypnotism is Prof. August Forel. In several articles on the subject (*Correspondenzbl. f. Schweizer Aerzte*, 1887; *München med. Wochenschr.* 1888, Nos. 5 and 13; noted in *Centbt. f. Physiol.* No. 5, 1888), he makes clear his conviction that hypnotism is a genuine remedial agent, adapted, however, rather to functional nervous disorders of mentally sound patients (pains, chronic rheumatism, insomnia, etc.) than to psychoses. It succeeds best, of course, with those most open to suggestion, and whose disease is of recent origin. Prof. Forel has been successful in treating alcohol and morphine habit in this way, securing in some cases what seems to be a complete cure. He belongs to the Nancy school, and hypnotizes by suggestion.

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